NEET UG 2023

Date : 7 May 2023

Booklet Code : F1

Time : 3 Hrs 20 Min **Maximum Marks : 720**

Important Instructions :

1. The test is of **3 hours 20 minutes** duration and the Test Booklet contains **200** multiple choice questions (four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology). 50** questions in each subject are divided into **two sections (A and B)** as per details given below:
   (a) **Section A** shall consist of **35 (Thirty-five)** Questions in each subject (Question Nos. – 1 to 35, 51 to 85, 101 to 135 and 151 to 185). All Questions are compulsory.
   (b) **Section B** shall consist of **15 (Fifteen)** questions in each subject (Question Nos. – 36 to 50, 86 to 100, 136 to 150 and 186 to 200). In section B, a candidate needs to **attempt any 10 (Ten)** questions out of **15 (Fifteen)** in each subject.

   Candidates are advised to read all 15 questions in each subject of Section-B before they start attempting the question paper. In the event of a candidate attempting more than ten questions, **the first ten questions answered by the candidate shall be evaluated.**
2. Each question carries **4 marks**. For each correct response, the candidate will get **4 marks**. For each incorrect response, **1 mark** will be deducted from the total scores. The maximum marks are **720**.
3. Use **Blue / Black Ball point Pen only** for writing particulars on this page / marking responses on Answer Sheet.
4. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
5. On completion of the test, the candidate **must handover the Answer Sheet (ORIGINAL and OFFICE Copy)** to the **Invigilator** before leaving the Room/Hall. The candidates are allowed to take away this Test Booklet with them.
6. The CODE for this Booklet is **F1**.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
8. Each candidate must show on-demand his/her Admit Card to the Invigilator.
9. No candidate, without special permission of the Centre Superintendent or Invigilator, would leave his/her seat.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Room/Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination.
12. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
13. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

PHYSICS

SECTION-A

1. The ratio of radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of the thin hollow sphere of same mass and radius about its axis is

(1) 5 : 3

(2) 2 : 5

(3) 5 : 2

(4) 3 : 5

Answer (4*)

Sol. Radius of gyration of solid sphere about its own axis = $\sqrt{\frac{2}{5}}R$

Radius of gyration of hollow sphere about its own axis = $\sqrt{\frac{2}{3}}R$

$\Rightarrow$ Required ratio = $\sqrt{\frac{2}{5}} \times \sqrt{\frac{3}{2}} = \sqrt{\frac{3}{5}}$

* None of the option is correct (correct answer is $\sqrt{\frac{3}{5}}$)

2. The work functions of Caesium (Cs), Potassium (K) and Sodium (Na) are 2.14 eV, 2.30 eV and 2.75 eV respectively. If incident electromagnetic radiation has an incident energy of 2.20 eV, which of these photosensitive surfaces may emit photoelectrons?

(1) Both Na and K

(2) K only

(3) Na only

(4) Cs only

Answer (4)

Sol. Energy of incident radiation = 2.80 eV

Work function of Cs $\rightarrow$ 2.14 eV

Work function of K $\rightarrow$ 2.30 eV

Work function of Na $\rightarrow$ 2.75 eV

Since the work function of potassium and sodium are more than energy of incident radiation hence photons may be emitted from caesium.

3. The amount of energy required to form a soap bubble of radius 2 cm from a soap solution is nearly (surface tension of soap solution = 0.03 N m^{-1})

(1) 5.06×10^{-4} J

(2) 3.01×10^{-4} J

(3) 50.1×10^{-4} J

(4) 30.16×10^{-4} J

Answer (2)

Sol. Amount of energy required = $[S \times \Delta A] \times 2$

$\Rightarrow$ Energy required = $[0.03 \times 4 \times \pi \times 4 \times 10^{-4}] \times 2$

$= 3.015 \times 10^{-4}$ J

4. Resistance of a carbon resistor determined from colour codes is (22000 ± 5%) Ω. The colour of third band must be

(1) Green

(2) Orange

(3) Yellow

(4) Red

Answer (2)

Sol. Resistance = $(22 \times 10^3)\ \Omega \pm 5\%$

Third band corresponds to decimal multiplier.

Decimal multiplier = 10^3

$\Rightarrow$ Colour $\rightarrow$ Orange

5. In a series *LCR* circuit, the inductance *L* is 10 mH, capacitance *C* is 1 μF and resistance *R* is 100 Ω. The frequency at which resonance occurs is

(1) 15.9 kHz

(2) 1.59 rad/s

(3) 1.59 kHz

(4) 15.9 rad/s

Answer (3)

Sol. For resonance frequency = $\dfrac{1}{2\pi\sqrt{LC}}$

$$\Rightarrow \quad f = \frac{1}{2\times\pi\times\sqrt{10\times10^{-3}\times1\times10^{-6}}} = \frac{10^4}{2\pi}$$

$= 1.591 \times 10^3$

$= 1.591$ kHz

6. In a plane electromagnetic wave travelling in free space, the electric field component oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V m^{-1}. Then the amplitude of oscillating magnetic field is (Speed of light in free space = 3×10^8 m s^{-1})

(1) 1.6×10^{-8} T

(2) 1.6×10^{-7} T

(3) 1.6×10^{-6} T

(4) 1.6×10^{-9} T

Answer (2)

Sol. From the properties of electromagnetic wave

we know that, $C = \dfrac{E_0}{B_0}$

$E_0 \Rightarrow$ Amplitude of oscillating electric field

$B_0 \Rightarrow$ Amplitude of oscillating magnetic field

$$\Rightarrow B_0 = \frac{48}{3\times10^8} = 1.6\times10^{-7}\ \text{T}$$

7. Given below are two statements:

Statement I: Photovoltaic devices can convert optical radiation into electricity.

Statement II: Zener diode is designed to operate under reverse bias in breakdown region.

In the light of the above statements, choose the ***most appropriate*** answer from the options given below.

(1) Both Statement I and Statement II are incorrect

(2) Statement I is correct but Statement II is incorrect

(3) Statement I is incorrect but Statement II is correct

(4) Both Statement I and Statement II are correct

Answer (4)

Sol. Both Statements are correct.

I: Photovoltaic devices convert optical radiation into electricity.

II: Zener diode is designed to operate under reverse bias in breakdown region.

e.g., Zener diode as a voltage regulator.

8. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are

(1) Personal errors

(2) Least count errors

(3) Random errors

(4) Instrumental errors

Answer (3)

Sol. The errors which cannot be associated with any systematic or constant cause are called random errors. These errors can arise due to unpredictable fluctuations in experimental conditions. *e.g.,* random change in pressure, temperature, voltage supply etc.

9. If $\oint_s \vec{E} \cdot \overrightarrow{dS} = 0$ over a surface, then

(1) The magnitude of electric field on the surface is constant

(2) All the charges must necessarily be inside the surface

(3) The electric field inside the surface is necessarily uniform

(4) The number of flux lines entering the surface must be equal to the number of flux lines leaving it

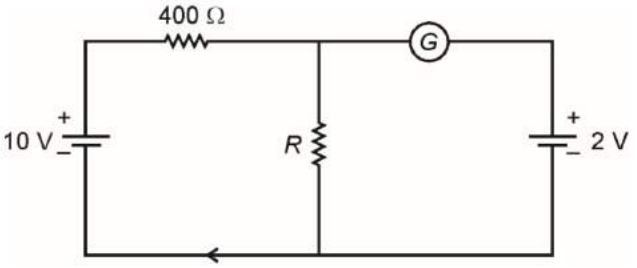
Answer (4)

Sol. $\phi_{net} = \oint_s \vec{E} \cdot \overrightarrow{dS} = 0$

$\Rightarrow$ Net flux through surface is zero.

$\Rightarrow$ Therefore, the number of flux lines entering the surface must be equal to the number of flux lines leaving it.

10. If the galvanometer G does not show any deflection in the circuit shown, the value of R is given by



(1) 50 Ω

(2) 100 Ω

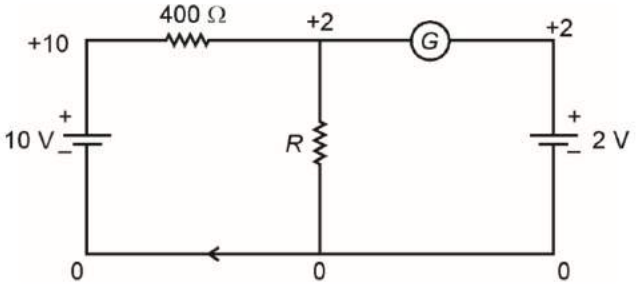
(3) 400 Ω

(4) 200 Ω

Answer (2)

Sol. Since galvanometer does not show any deflection

$\Rightarrow i_g = 0$



$$\frac{10-2}{400} = \frac{2}{R} \quad \Rightarrow R = \frac{2 \times 400}{8} = 100\ \Omega$$

11. An ac source is connected to a capacitor C. Due to decrease in its operating frequency

(1) Displacement current increases

(2) Displacement current decreases

(3) Capacitive reactance remains constant

(4) Capacitive reactance decreases

Answer (2)

Sol. $X_C = \frac{1}{\omega C}$

Since ω decreasing X_C will increases hence current will decreases also

conduction current = displacement current

Therefore displacement current will decrease.

12. The minimum wavelength of X-rays produced by an electron accelerated through a potential difference of V volts is proportional to

(1) $\frac{1}{V}$

(2) $\frac{1}{\sqrt{V}}$

(3) V^2

(4) $\sqrt{V}$

Answer (1)

Sol. $eV = \frac{hc}{\lambda_{min}}$

$\lambda_{min} = \frac{hc}{eV}$

$\lambda_{min} \propto \frac{1}{V}$

13. The venturi-meter works on

(1) Bernoulli's principle

(2) The principle of parallel axes

(3) The principle of perpendicular axes

(4) Huygens's principle

Answer (1)

Sol. Venturi-meter works on the Bernoulli's principle.

14. A full wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor and a load resistance. Which of these components remove the ac ripple from the rectified output?

(1) p-n junction diodes

(2) Capacitor

(3) Load resistance

(4) A centre-tapped transformer

Answer (2)

Sol. Capacitor removes the ac ripple from rectified output.

15. A metal wire has mass (0.4 ± 0.002) g, radius (0.3 ± 0.001) mm and length (5 ± 0.02) cm. The maximum possible percentage error in the measurement of density will nearly be

(1) 1.3%

(2) 1.6%

(3) 1.4%

(4) 1.2%

Answer (2)

Sol. We know, $\rho = \frac{\text{Mass}}{\text{Volume}} = \frac{M}{\pi r^2 \ell}$

Using the concept of errors we know,

$\frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + \frac{2\Delta r}{r} + \frac{\Delta \ell}{\ell}$

$= \left(\frac{0.002}{0.4} + \frac{2 \times 0.001}{0.3} + \frac{0.02}{5}\right)$

$\frac{\Delta\rho}{\rho} = 0.0156$

$\frac{\Delta\rho}{\rho}\% = 1.56\% \approx 1.6\%$

16. For Young's double slit experiment, two statements are given below:

Statement I : If screen is moved away from the plane of slits, angular separation of the fringes remains constant.

Statement II : If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.

In the light of the above statements, choose the *correct* answer from the options given below:

(1) Both Statement I and Statement II are false.

(2) Statement I is true but Statement II is false.

(3) Statement I is false but Statement II is true.

(4) Both Statement I and Statement II are true.

Answer (2)

Sol. For YDSE, angular fringe width is given by $\alpha = \frac{\lambda}{d}$

It does not depend on the distance of screen from the slit, so statement I is correct.

Angular fringe width $\propto \lambda$

If $\lambda \uparrow \rightarrow$ angular separation of fringes increases

So, statement I is true and statement II is false.

17. The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm, potential energy stored in it will be

(1) 4 U

(2) 8 U

(3) 16 U

(4) 2 U

Answer (3)

Sol. Potential energy stored in spring $U = \frac{1}{2}Kx^2$

$U = \frac{1}{2}K(2)^2$ where x = 2 cm

$U = \frac{1}{2}(K)\cdot(4)$

$U = 2K$ ....(i)

$U' = \frac{1}{2}K(8)^2$

$U' = \frac{1}{2}K \times 64 = 32K$ ....(ii)

On dividing (i) by (ii)

$\frac{U}{U'} = \frac{2K}{32K} = \frac{1}{16}$

$U' = 16\,U$

18. Light travels a distance x in time t_1 in air and $10x$ in time t_2 in another denser medium. What is the critical angle for this medium?

(1) $\sin^{-1}\left(\frac{10t_2}{t_1}\right)$

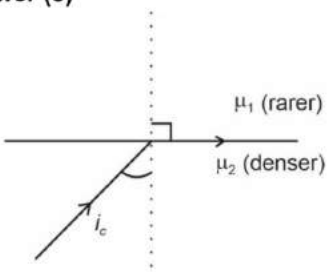
(2) $\sin^{-1}\left(\frac{t_1}{10\,t_2}\right)$

(3) $\sin^{-1}\left(\frac{10\,t_1}{t_2}\right)$

(4) $\sin^{-1}\left(\frac{t_2}{t_1}\right)$

Answer (3)

Sol.



$\mu_2 \sin i_c = \mu_1$

$\sin i_c = \frac{\mu_1}{\mu_2}$

$\mu = \frac{c}{V}$

So $\sin i_c = \frac{\mu_1}{\mu_2} = \frac{V_2}{V_1}$

$\sin i_c = \frac{10xt_1}{t_2 x}$

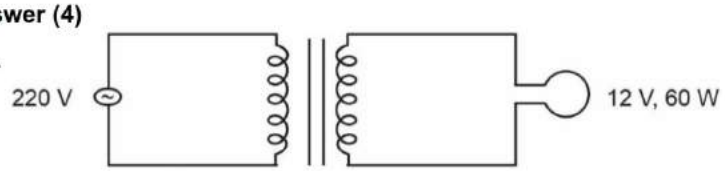
$i_c = \sin^{-1}\left(\frac{10t_1}{t_2}\right)$

19. A 12 V, 60 W lamp is connected to the secondary of a step-down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding?

(1) 2.7 A
(2) 3.7 A
(3) 0.37 A
(4) 0.27 A

Answer (4)

Sol.



For ideal transformer

$P_{input} = P_{output}$

$(VI)_{in} = 60$

$220 \times I = 60$

$I = 0.27$ A

20. A football player is moving southward and suddenly turns eastward with the same speed to avoid an opponent. The force that acts on the player while turning is

(1) Along northward

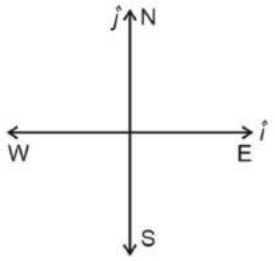
(2) Along north-east

(3) Along south-west

(4) Along eastward

Answer (2)

Sol.



$\Delta\vec{P} = \vec{P}_f - \vec{P}_i$

$\vec{P}_f = mu\hat{i}$

$\vec{P}_i = mu(-\hat{j})$

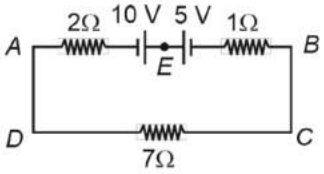
$\Delta\vec{P} = mu\hat{i} - mu(-\hat{j})$

$\Delta\vec{P} = mu(\hat{i} + \hat{j})$

$\vec{F} = \dfrac{\Delta\vec{P}}{\Delta t}$

Direction of change of momentum and direction of force acting on the player will be same, so correct answer is North east direction

21. The magnitude and direction of the current in the following circuit is



(1) 0.5 A from *A* to *B* through *E*

(2) $\frac{5}{9}$ A from *A* to *B* through *E*

(3) 1.5 A from *B* to *A* through *E*

(4) 0.2 A from *B* to *A* through *E*

Answer (1)

Sol. Using Kirchhoff's law

$i = \dfrac{10-5}{10} = \dfrac{5}{10}$

$i = 0.5$ A

In clock-wise direction (from *A* to *B*)

22. The angular acceleration of a body, moving along the circumference of a circle, is

(1) Along the radius towards the centre

(2) Along the tangent to its position

(3) Along the axis of rotation

(4) Along the radius, away from centre

Answer (3)

Sol. Angular acceleration of a body, moving along the circumference of a circle is along the axis of rotation.

23. A bullet is fired from a gun at the speed of 280 m s^{-1} in the direction 30° above the horizontal. The maximum height attained by the bullet is (g = 9.8 m s^{-2}, sin30° = 0.5)

(1) 2000 m

(2) 1000 m

(3) 3000 m

(4) 2800 m

Answer (2)

Sol. $H = \dfrac{u^2 \sin^2 \theta}{2g}$

$$H = \frac{(280)^2(\sin^2 30)}{2 \times 9.8}$$

$$= \frac{280 \times 280 \times 0.5 \times 0.5}{2 \times 9.8}$$

H = 1000 m

24. The net magnetic flux through any closed surface is

(1) Positive

(2) Infinity

(3) Negative

(4) Zero

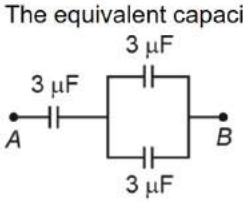
Answer (4)

Sol. $\oint \vec{B} \cdot \vec{ds} = \text{zero}$

Magnetic monopole doesn't exist.

Hence net magnetic flux through any closed surface is zero.

25. The equivalent capacitance of the system shown in the following circuit is



(1) 3 μF

(2) 6 μF

(3) 9 μF

(4) 2 μF

Answer (4)

Sol. For parallel grouping

$C_1 = 3 + 3 = 6\ \mu F$

For series grouping

$$C_{eq} = \frac{C_1C_2}{C_1 + C_2} = \frac{3 \times 6}{3 + 6} = \frac{18}{9}$$

$C_{eq} = 2\ \mu F$

26. A vehicle travels half the distance with speed v and the remaining distance with speed $2v$. Its average speed is

(1) $\frac{2v}{3}$

(2) $\frac{4v}{3}$

(3) $\frac{3v}{4}$

(4) $\frac{v}{3}$

Answer (2)

Sol. $$v_{avg} = \frac{2v_1v_2}{v_1 + v_2}$$

$$= \frac{2 \times v \times 2v}{v + 2v}$$

$$= \frac{4v}{3}$$

27. The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drops to $\left(\frac{1}{16}\right)^{th}$ of its initial value?

(1) 40 minutes

(2) 60 minutes

(3) 80 minutes

(4) 20 minutes

Answer (3)

Sol. $$A = \frac{A_0}{2^n}$$

$$\frac{A}{A_0} = \frac{1}{2^n}$$

$$\frac{1}{16} = \frac{1}{2^n}$$

$$\frac{1}{2^4} = \frac{1}{2^n}$$

$n = 4$

$$n = \frac{t}{T_{\frac{1}{2}}},\ t = 4 \times T_{\frac{1}{2}} = 4 \times 20$$

= 80 minutes

28. The temperature of a gas is –50°C. To what temperature the gas should be heated so that the rms speed is increased by 3 times?

(1) 3295°C

(2) 3097 K

(3) 223 K

(4) 669°C

Answer (1)

Sol. $v_{rms} = \sqrt{\frac{3RT}{m}}$

$v_{rms} \propto \sqrt{T}$

v_{rms} is increased by 3 times

So, final rms speed = $v + 3v = 4v$

$T_1 = 273 - 50$

$= 223$ K

$T_2 = ?$

$$\frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{v}{4v} = \sqrt{\frac{223}{T_2}} \Rightarrow \frac{1}{16} = \frac{223}{T_2}$$

$T_2 = 3568$ K

$T_2 = 3568 - 273 = 3295$°C

29. A Carnot engine has an efficiency of 50% when its source is at a temperature 327°C. The temperature of the sink is

(1) 15°C

(2) 100°C

(3) 200°C

(4) 27°C

Answer (4)

Sol. Efficiency $\eta = \frac{50}{100} = \frac{1}{2}$

Efficiency of Carnot engine

$$\eta = 1 - \frac{T_2}{T_1}$$

$$\eta = 1 - \frac{T_2}{600}$$

$$\frac{1}{2} = 1 - \frac{T_2}{600}$$

$$\frac{T_2}{600} = \frac{1}{2} \Rightarrow T_2 = 300\text{ K}$$

$T_2 = 300 - 273 = 27$°C

30. The magnetic energy stored in an inductor of inductance 4 μH carrying a current of 2 A is

(1) 4 mJ

(2) 8 mJ

(3) 8 μJ

(4) 4 μJ

Answer (3)

Sol. Magnetic energy stored in an inductor

$$U = \frac{1}{2}Li^2$$

$$= \frac{1}{2} \times 4 \times 10^{-6} \times (2)^2$$

$$= 8 \times 10^{-6}\ \text{J}$$

$$U = 8\ \mu\text{J}$$

31. Let a wire be suspended from the ceiling (rigid support) and stretched by a weight W attached at its free end. The longitudinal stress at any point of cross-sectional area A of the wire is

(1) W/A

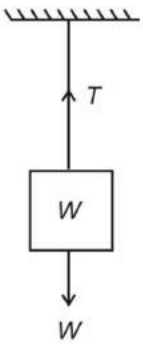
(2) $W/2A$

(3) Zero

(4) $2W/A$

Answer (1)

Sol.



$$\text{Longitudinal stress} = \frac{\text{Internal restoring force}}{\text{Area}} = \frac{F_{ext}}{\text{Area}}$$

$$\text{Stress} = \frac{W}{A}$$

32. An electric dipole is placed at an angle of 30° with an electric field of intensity 2×10^5 N C^{-1}. It experiences a torque equal to 4 N m. Calculate the magnitude of charge on the dipole, if the dipole length is 2 cm.

(1) 6 mC

(2) 4 mC

(3) 2 mC

(4) 8 mC

Answer (3)

Sol. $E = 2 \times 10^5$ N/C

$l = 2$ cm

$\tau = 4$ Nm

$\vec{\tau} = \vec{p} \times \vec{E}$

$4 = pE\sin\theta$

$4 = p \times 2 \times 10^5 \times \sin 30°$

$p = 4 \times 10^{-5}$ cm

$$q = \frac{p}{l} = \frac{4 \times 10^{-5}}{0.02} = 2 \text{ mC}$$

33. In hydrogen spectrum, the shortest wavelength in the Balmer series is λ. The shortest wavelength in the Bracket series is

(1) 4λ

(2) 9λ

(3) 16λ

(4) 2λ

Answer (1)

Sol. $\frac{1}{\lambda} = R\left[\frac{1}{n_2^2} - \frac{1}{n_1^2}\right]$

For Balmer [$n_2 = 2$, $n_1 = \infty$]

$$\frac{1}{\lambda} = R\left[\frac{1}{4} - \frac{1}{\infty}\right]$$

$$\lambda = \frac{4}{R} \quad \ldots(1)$$

For Bracket, ($n_2 = 4$, $n_1 = \infty$)

$$\frac{1}{\lambda'} = R\left[\frac{1}{16} - \frac{1}{\infty}\right]$$

$$\lambda' = \frac{16}{R} \quad \ldots(2)$$

$$\frac{\text{Eq}^n(1)}{\text{Eq}^n(2)}$$

$\lambda' = 4\lambda$

34. The ratio of frequencies of fundamental harmonic produced by an open pipe to that of closed pipe having the same length is

(1) 2 : 1

(2) 1 : 3

(3) 3 : 1

(4) 1 : 2

Answer (1)

Sol. $f_0 = f_{\text{open pipe}} = \frac{v}{2l}$

$f_c = f_{\text{closed pipe}} = \frac{v}{4l}$

$\frac{f_0}{f_c} = \frac{v}{2l} \times \frac{4l}{v}$

$f_0 : f_c = 2 : 1$

35. Two bodies of mass m and $9m$ are placed at a distance R. The gravitational potential on the line joining the bodies where the gravitational field equals zero, will be (G = gravitational constant)

(1) $-\frac{12Gm}{R}$

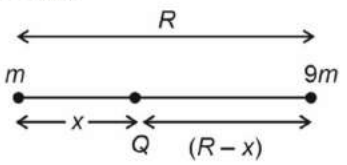
(2) $-\frac{16Gm}{R}$

(3) $-\frac{20Gm}{R}$

(4) $-\frac{8Gm}{R}$

Answer (2)

Sol.



Let electric field at point Q be zero

So,

$\frac{Gm}{x^2} = \frac{G(9m)}{(R-x)^2}$

$\frac{(R-x)^2}{x^2} = 9$

$x = \frac{R}{4}$

$V_P = \frac{-Gm}{x} - \frac{G(9m)}{R-x}$

$V_P = \frac{-Gm}{\frac{R}{4}} - \frac{G(9m)}{\frac{3R}{4}}$

$= \frac{-4Gm}{R} - \frac{12Gm}{R}$

$= \frac{-16Gm}{R}$

SECTION-B

36. A bullet from a gun is fired on a rectangular wooden block with velocity u. When bullet travels 24 cm through the block along its length horizontally, velocity of bullet becomes $\frac{u}{3}$. Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is

(1) 24 cm

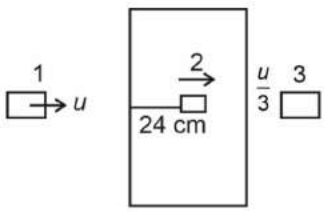
(2) 28 cm

(3) 30 cm

(4) 27 cm

Answer (4)

Sol.



between 1 to 2

$$\left(\frac{u}{3}\right)^2 = u^2 - 2a \times 24$$

$$\Rightarrow 2a(24) = \frac{8u^2}{9} \qquad ...(\text{I})$$

between 2 to 3

$$0 = \left(\frac{u}{3}\right)^2 - 2as \quad ...(\text{II})$$

From equation (I) and (II)

$$2as = \frac{2a(24)}{8}$$

$$\boxed{s = 3 \text{ cm}}$$

Length of wooden block is 24 + 3 = 27 cm

37. The radius of inner most orbit of hydrogen atom is 5.3×10^{-11} m. What is the radius of third allowed orbit of hydrogen atom?

(1) 1.06 Å

(2) 1.59 Å

(3) 4.77 Å

(4) 0.53 Å

Answer (3)

Sol. $r_n = \frac{n^2}{Z}$

$$\frac{r_1}{r_2} = \left(\frac{1}{3}\right)^2$$

$$r_2 = 9r_1 = 5.3 \times 10^{-11} \times 9$$

$$= 47.7 \times 10^{-11}$$

$$= 4.77 \text{ Å}$$

38. Calculate the maximum acceleration of a moving car so that a body lying on the floor of the car remains stationary. The coefficient of static friction between the body and the floor is 0.15 (g = 10 m s^{-2}).

(1) 150 m s^{-2}

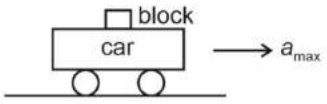
(2) 1.5 m s^{-2}

(3) 50 m s^{-2}

(4) 1.2 m s^{-2}

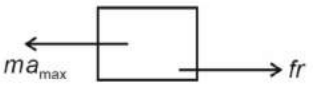
Answer (2)

Sol.



w.r.t. car

$a_b = 0$



$ma_{max} = \mu_s mg$

$a_{max} = \mu_s g = 0.15 \times 10 = 1.5$ m/s^2

39. 10 resistors, each of resistance R are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased n times. The value of n is

(1) 100

(2) 1

(3) 1000

(4) 10

Answer (1)

Sol. In series combination

$R_{eq} = 10R$

$$i = \frac{E}{10R}$$

In parallel combination

$$R_{eq} = \frac{R}{10}$$

$$i' = \frac{E}{\frac{R}{10}} = \frac{10\,E}{R}$$

$i' = 10 \times 10\, i = 100\, i$

$$\boxed{n = 100}$$

40. A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity 4 m s^{-1}. The ball strikes the water surface after 4 s. The height of bridge above water surface is (Take g = 10 m s^{-2})

(1) 60 m

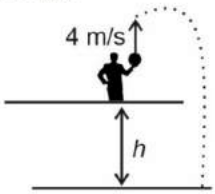
(2) 64 m

(3) 68 m

(4) 56 m

Answer (2)

Sol.



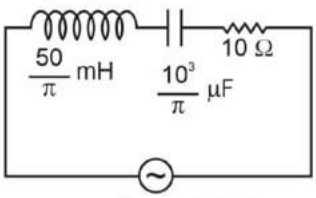
$$s = ut - \frac{1}{2}gt^2$$

$$= 16 - \frac{1}{2} \times 10 \times 16$$

$$= -64 \text{ m}$$

Height of bridge above water surface = 64 m

41. The net impedance of circuit (as shown in figure) will be



220 V, 50 Hz

(1) 15 Ω

(2) $5\sqrt{5}$ Ω

(3) 25 Ω

(4) $10\sqrt{2}$ Ω

Answer (2)

Sol. $L = \frac{50}{\pi}$ mH

$$X_L = 2\pi \times 50 \times \frac{50}{\pi} \times 10^{-3} = 5\ \Omega$$

$$C = \frac{10^3}{\pi} \times 10^{-6}$$

$$X_C = \frac{1 \times \pi}{2\pi \times 50 \times 10^3 \times 10^{-6}} = \frac{10^3}{100} = 10\ \Omega$$

$$Z = \sqrt{(X_C - X_L)^2 + R^2}$$

$$Z = \sqrt{(10-5)^2 + 10^2} = \sqrt{125} = 5\sqrt{5}\ \Omega$$

42. A satellite is orbiting just above the surface of the earth with period T. If d is the density of the earth and G is the universal constant of gravitation, the quantity $\frac{3\pi}{Gd}$ represents

(1) T^2
(2) T^3
(3) $\sqrt{T}$
(4) T

Answer (1)

Sol. Time period of satellite above earth surface

$$T = 2\pi\sqrt{\frac{R^3}{GM}} = 2\pi\sqrt{\frac{R^3}{Gd\frac{4}{3}\pi R^3}}$$

$$T = 2\pi\sqrt{\frac{3}{4\pi Gd}}$$

$$\boxed{T = \sqrt{\frac{3\pi}{Gd}}} \quad \boxed{T^2 = \frac{3\pi}{Gd}}$$

43. Two thin lenses are of same focal lengths (f), but one is convex and the other one is concave. When they are placed in contact with each other, the equivalent focal length of the combination will be

(1) $\frac{f}{4}$
(2) $\frac{f}{2}$
(3) Infinite
(4) Zero

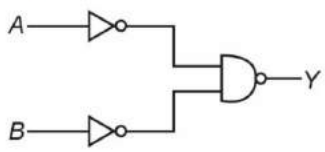
Answer (3)

Sol. Convex lens $f_1 > 0$, concave lens $f_2 < 0$

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{f} - \frac{1}{f} = 0$$

$$\boxed{f_{eq} = \infty}$$

44. For the following logic circuit, the truth table is



(1)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(2)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

(3)

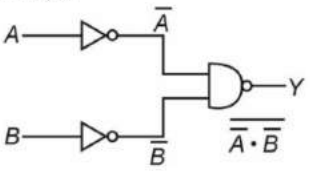
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(4)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Answer (1)

Sol.

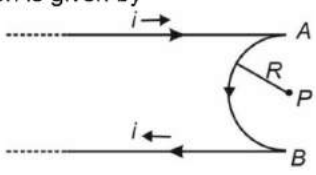


$Y = \overline{\overline{A}\cdot\overline{B}} = A + B$

It is OR gate.

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

45. A very long conducting wire is bent in a semi-circular shape from A to B as shown in figure. The magnetic field at point P for steady current configuration is given by



(1) $\frac{\mu_0 i}{4R}$ pointed away from the page

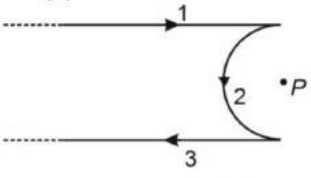
(2) $\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed away from page

(3) $\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed into the page

(4) $\frac{\mu_0 i}{4R}$ pointed into the page

Answer (2)

Sol.



B_P due to wire 1 $= \frac{\mu_0 i}{4\pi R}\otimes$

B_P due to wire 3 $= \frac{\mu_0 i}{4\pi R} \otimes$

B_P due to wire 2 $= \frac{\mu_0 i}{4R} \odot$

$$B_{net} = -\frac{\mu_0 i}{2\pi R} + \frac{\mu_0 i}{4R} = \frac{\mu_0 i}{4R}\left[-\frac{2}{\pi}+1\right] = \frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$$

Pointed away from page.

46. The resistance of platinum wire at 0°C is 2 Ω and 6.8 Ω at 80°C. The temperature coefficient of resistance of the wire is

(1) 3×10^{-3} °C^{-1}

(2) 3×10^{-2} °C^{-1}

(3) 3×10^{-1} °C^{-1}

(4) 3×10^{-4} °C^{-1}

Answer (2)

Sol. Using $R = R_0(1 + \alpha\Delta T)$

where α is the thermal coefficient of resistance

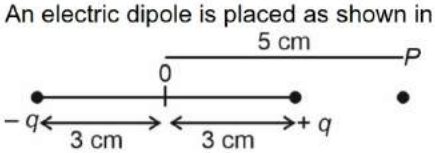
$6.8 = 2\{1 + \alpha(80 - 0)\}$

$$\frac{6.8}{2} - 1 = \alpha \times 80$$

$$\alpha = \frac{3.4-1}{80} = \frac{2.4}{80} = 0.03$$

$\therefore\ \alpha = 3 \times 10^{-2}$ °C^{-1}

47. An electric dipole is placed as shown in the figure.



The electric potential (in 10^2 V) at point P due to the dipole is (ϵ_0 = permittivity of free space and $\frac{1}{4\pi\epsilon_0} = K$)

(1) $\left(\frac{5}{8}\right)qK$

(2) $\left(\frac{8}{5}\right)qK$

(3) $\left(\frac{8}{3}\right)qK$

(4) $\left(\frac{3}{8}\right)qK$

Answer (4)

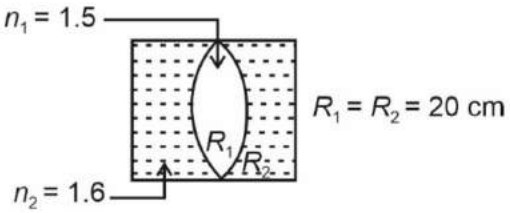
Sol. Electrostatic potential due to a point charge is given by $\frac{Kq}{r}$

$$V_{\text{net at point } P} = \frac{Kq}{2\times10^{-2}} - \frac{Kq}{8\times10^{-2}}$$

$$= \frac{Kq\times10^2}{2}\left(1-\frac{1}{4}\right)$$

$$= \left(\frac{3}{8}Kq\right)\times10^2 \text{ V} = \frac{3}{8}qK$$

48. In the figure shown here, what is the equivalent focal length of the combination of lenses (Assume that all layers are thin)?



(1) –40 cm

(2) –100 cm

(3) –50 cm

(4) 40 cm

Answer (2)

Sol. Effective focal length $\Rightarrow f_{eff}$

$$\frac{1}{f_{eff}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$

Also, $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$$\frac{1}{f_1} = (1.6 - 1)\left(\frac{1}{\infty} - \frac{1}{20}\right) = \frac{-0.6}{20}$$

$$\frac{1}{f_2} = (1.5 - 1)\left(\frac{1}{20} - \frac{1}{-20}\right) = \frac{0.5}{10}$$

$$\frac{1}{f_3} = (1.6 - 1)\left(\frac{1}{-20} - \frac{1}{\infty}\right) = \frac{-0.6}{20}$$

$$\frac{1}{f_{eff}} = \frac{-0.6}{20} + \frac{0.5}{10} - \frac{0.6}{20}$$

$$\frac{1}{f_{eff}} = \frac{-0.6}{10} + \frac{0.5}{10} = \frac{-0.1}{10} = \frac{-1}{100}$$

$\therefore$ $f_{eff} = -100$ cm

49. A wire carrying a current I along the positive x-axis has length L. It is kept in a magnetic field $\vec{B} = (2\hat{i} + 3\hat{j} - 4\hat{k})$ T. The magnitude of the magnetic force acting on the wire is

(1) $\sqrt{5}\,IL$

(2) $5\,IL$

(3) $\sqrt{3}\,IL$

(4) $3\,IL$

Answer (2)

Sol. Magnetic force acting on a current carrying wire is

$$\vec{F} = I\vec{\ell} \times \vec{B}$$

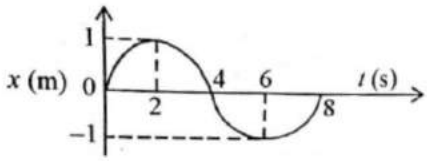
$$= IL\hat{i} \times \left(2\hat{i} + 3\hat{j} - 4\hat{k}\right) = 3IL\hat{k} + 4IL\hat{j}$$

Magnitude of force

$$|\vec{F}| = \sqrt{(3IL)^2 + (4IL)^2}$$

$$= 5IL$$

50. The x-t graph of a particle performing simple harmonic motion is shown in the figure. The acceleration of the particle at $t = 2$ s is



(1) $-\frac{\pi^2}{8}$ m s^{-2}

(2) $\frac{\pi^2}{16}$ m s^{-2}

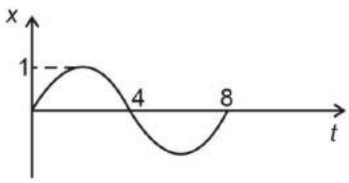
(3) $-\frac{\pi^2}{16}$ m s^{-2}

(4) $\frac{\pi^2}{8}$ m s^{-2}

Answer (3)

Sol. Position of particle as function of time

$x = A\sin\omega t$



From figure,

$A = 1$

$$\omega = \frac{2\pi}{8}$$

$$x = \sin\frac{\pi}{4}t$$

$$v = \frac{dx}{dt}$$

$$v = \frac{\pi}{4}\cos\frac{\pi}{4}t$$

$$a = \frac{dv}{dt}$$

$$a = -\frac{\pi^2}{16}\sin\frac{\pi}{4}t$$

at $t = 2$ s

$$a = -\frac{\pi^2}{16} \text{ m/s}^2$$

CHEMISTRY

SECTION-A

51. The stability of Cu^{2+} is more than Cu^{+} salts in aqueous solution due to

(1) Enthalpy of atomization

(2) Hydration energy

(3) Second ionisation enthalpy

(4) First ionisation enthalpy

Answer (2)

Sol. The stability of $Cu^{2+}(aq)$ is more than $Cu^{+}(aq)$ is due to the much more negative $\Delta_{hyd}H°$ of $Cu^{2+}(aq)$ than $Cu^{+}(aq)$, which more than compensates for second ionisation enthalpy of Cu.

$\Delta_{hyd}H°$ of $Cu^{2+}(aq) = -2121$ kJ mol^{-1}

$\Delta_{i}H_1^{o}$ of Cu = +745 kJ mol^{-1}

$\Delta_{i}H_2^{o}$ of Cu = +1960 kJ mol^{-1}

52. Which one is an example of heterogenous catalysis?

(1) Hydrolysis of sugar catalysed by H^{+} ions

(2) Decomposition of ozone in presence of nitrogen monoxide

(3) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron

(4) Oxidation of sulphur dioxide into sulphur trioxide in the presence of oxides of nitrogen

Answer (3)

Sol. Combination of N_2 and H_2 to form NH_3 in presence of finely divided Fe is an example of heterogeneous catalysis.

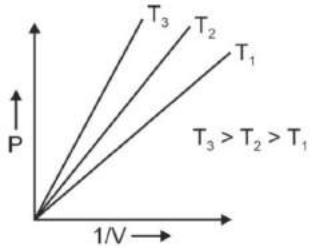
$$N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$$

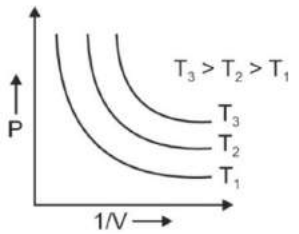
All other are examples of homogeneous catalysis.

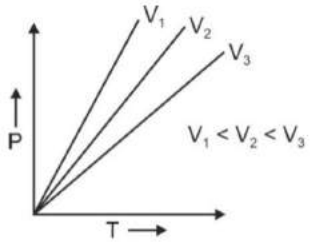
$$C_{12}H_{22}O_{11}(aq) + H_2O(l) \xrightarrow{H_2SO_4(l)} \text{Glucose}(aq) + \text{Fructose}(aq)$$

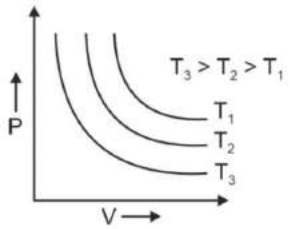
$$2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$$

53. Which amongst the following options are **correct** graphical representation of Boyle's law?

(1)


(2)


(3)


(4)


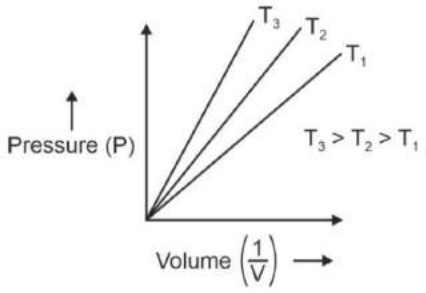
Answer (1)

Sol. According to Boyle's law,

$PV = nRT$

$P = nRT\left(\frac{1}{V}\right)$

P versus $\left(\frac{1}{V}\right)$ gives straight line graph with slope nRT.



54. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R** :

Assertion A : A reaction can have zero activation energy.

Reasons R : The minimum extra amount of energy absorbed by reactant molecules so that their energy becomes equal to threshold value, is called activation energy.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **A** and **R** are true and **R** is **NOT** the correct explanation of **A**

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

(4) Both **A** and **R** are true and **R** is the correct explanation of **A**

Answer (1)

Sol.
- Few reactions can have zero activation energy for example radical reactions.
- Activation energy is defined as the minimum amount of extra energy absorbed by reactants to achieve threshold energy.

55. In Lassaigne's extract of an organic compound, both nitrogen and sulphur are present, which gives blood red colour with Fe^{3+} due to the formation of

(1) NaSCN

(2) $[Fe(CN)_5NOS]^{4-}$

(3) $[Fe(SCN)]^{2+}$

(4) $Fe_4[Fe(CN)_6]_3 \cdot xH_2O$

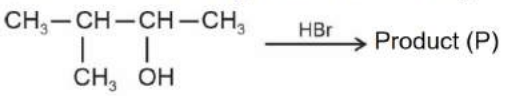
Answer (3)

Sol. In case, nitrogen and sulphur both are present in organic compound, sodium thiocyanate is formed. It gives blood red colour and no Prussian blue since there are no free cyanide ions.

$$Na + C + N + S \longrightarrow NaSCN$$

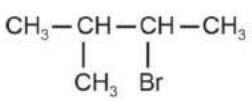
$$Fe^{3+} + SCN^{-} \longrightarrow \underset{\text{Blood red}}{[Fe(SCN)]^{2+}}$$

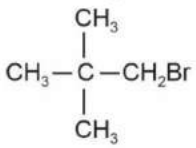
56. Consider the following reaction and identify the product (P).

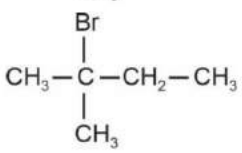


3-Methylbutan-2-ol

(1) $CH_3CH = CH - CH_3$

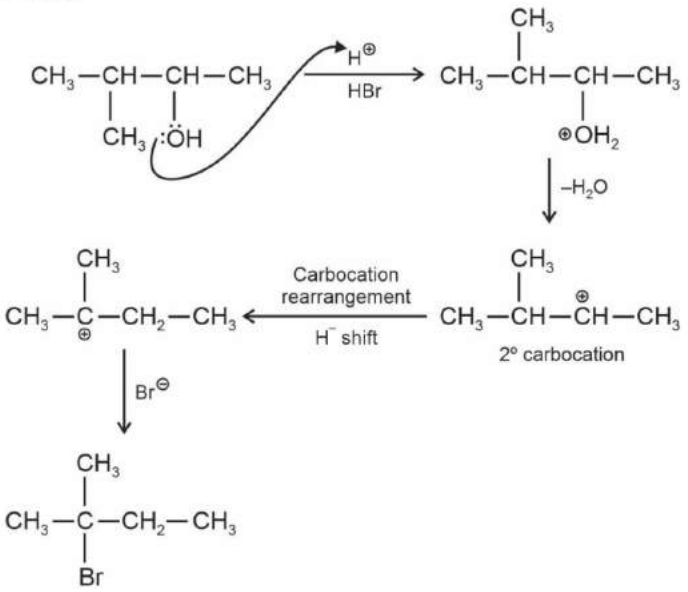
(2) 

(3) 

(4) 

Answer (4)

Sol.



57. For a certain reaction, the rate = $k[A]^2[B]$, when the initial concentration of A is tripled keeping concentration of B constant, the initial rate would

(1) Increase by a factor of six

(2) Increase by a factor of nine

(3) Increase by a factor of three

(4) Decrease by a factor of nine

Answer (2)

Sol. Rate (r) = $k[A]^2[B]$

When concentration of A is tripled

$[A'] = [3A]$

New rate, $r' = k[A']^2[B] = k[3A]^2[B] = 9k[A]^2[B]$

$r' = 9r$

58. Match **List-I** with **List-II**.

	List-I		**List-II**
A.	Coke	I.	Carbon atoms are sp^3 hybridised
B.	Diamond	II.	Used as a dry lubricant
C.	Fullerene	III.	Used as a reducing agent
D.	Graphite	IV.	Cage like molecules

Choose the **correct** answer from the options given below :

(1) A-IV, B-I, C-II, D-III

(2) A-III, B-I, C-IV, D-II

(3) A-III, B-IV, C-I, D-II

(4) A-II, B-IV, C-I, D-III

Answer (2)

Sol.
- Coke is largely used as a reducing agent in metallurgy.
- In diamond, each carbon atom undergoes sp^3 hybridisation and linked to four other carbon atoms by using hybridised orbitals in tetrahedral fashion.
- Buckminsterfullerene contains six membered and five membered rings and hence is a cage like molecule.
- Graphite is very soft and slippery. Hence, it is used as a dry lubricant in machines running at high temperature.

59. Which one of the following statements is **correct**?

(1) All enzymes that utilise ATP in phosphate transfer require Ca as the cofactor

(2) The bone in human body is an inert and unchanging substance

(3) Mg plays roles in neuromuscular function and interneuronal transmission

(4) The daily requirement of Mg and Ca in the human body is estimated to be 0.2-0.3 g

Answer (4)

Sol.
- All enzymes that utilize ATP in phosphate transfer require Mg as the co-factor.
- Bone in human body is not an inert and unchanging substance but is continuously being solubilised and redeposited.
- Ca plays important role in neuromuscular function, interneuronal transmission, cell membrane integrity and blood coagulation.
- The daily requirement of Mg and Ca in the human body is estimated to be 200 - 300 mg (0.2 - 0.3 g).

60. A compound is formed by two elements A and B. The element B forms cubic close packed structure and atoms of A occupy 1/3 of tetrahedral voids. If the formula of the compound is A_xB_y, then the value of x + y is in option

(1) 4

(2) 3

(3) 2

(4) 5

Answer (4)

Sol. Number of atoms of element B is N

So, the number of atoms of element A is $\frac{1}{3} \times 2N$

$\therefore$ The formula of the compound is $A_{\frac{2}{3}N}B_N = A_2B_3$

So, $x = 2$

$y = 3$

$\therefore$ $x + y = 5$

61. Homoleptic complex from the following complexes is

(1) Diamminechloridonitrito-N-platinum (II)

(2) Pentaamminecarbonatocobalt (III) chloride

(3) Triamminetriaquachromium (III) chloride

(4) Potassium trioxalatoaluminate (III)

Answer (4)

Sol. • Complexes in which a metal is bound to only one kind of donor groups are called as homoleptic complexes

• Potassium trioxalatoaluminate (III)

$K_3[Al(ox)_3]$

It is a homoleptic complex

62. The **correct** order of energies of molecular orbitals of N_2 molecule, is

(1) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

(2) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < \sigma^* 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y)$

(3) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma 2p_z < \sigma^* 2p_z$

(4) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

Answer (4)

Sol. For molecules like B_2, C_2, N_2 etc. the increasing order of energies of various molecular orbitals is

$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

63. Taking stability as the factor, which one of the following represents **correct** relationship?

(1) $InI_3 > InI$

(2) $AlCl > AlCl_3$

(3) $T\ell I > T\ell I_3$

(4) $T\ell Cl_3 > T\ell Cl$

Answer (3)

Sol. As we move down the group, due to poor shielding effect of intervening *d* and *f* orbitals, the increased effective nuclear charge holds ns electrons tightly and therefore restricting their participation in bonding.

So, the relative stability of +1 O.S increases for heavier elements.

E° for $In^{3+} | In^+ = -0.16$ V

E° for $T\ell^{3+} | T\ell^+ = +1.6$ V

Hence, $T\ell I$ is more stable than $T\ell I_3$

64. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R**

Assertion A : Helium is used to dilute oxygen in diving apparatus.

Reason R : Helium has high solubility in O_2.

In the light of the above statements, choose the **correct** answer from the options given below

(1) Both **A** and **R** are true and **R** is **NOT** the correct explanation of **A**

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

(4) Both **A** and **R** are true and **R** correct explanation of **A**

Answer (1)

Sol.
- Helium is used as diluent for oxygen in modern diving apparatus because of its very low solubility in blood.
- Gases diffuses easily with each other.

65. Select the **correct** statements from the following

A. Atoms of all elements are composed of two fundamental particles.

B. The mass of the electron is 9.10939×10^{-31} kg.

C. All the isotopes of a given element show same chemical properties:

D. Protons and electrons are collectively known as nucleons.

E. Dalton's atomic theory, regarded the atom as an ultimate particles of matter

Choose the **correct** answer from the options given below

(1) C, D and E only

(2) A and E only

(3) B, C and E only

(4) A, B and C only

Answer (3)

Sol.
- Atoms consist of three fundamental particles :

  Electrons, protons and neutrons
- The mass of the electron is 9.10939×10^{-31} kg
- All the isotopes of a given element show same chemical properties.
- Protons and neutrons present in the nucleus are collectively called as nucleons.
- Dalton's atomic theory, regarded the atom as the ultimate particle of matter

So, the correct statements are B, C, E only

66. Which of the following statements are **NOT** correct?

A. Hydrogen is used to reduce heavy metal oxides to metals.

B. Heavy water is used to study reaction mechanism.

C. Hydrogen is used to make saturated fats from oils.

D. The H–H bond dissociation enthalpy is lowest as compared to a single bond between two atoms of any elements.

E. Hydrogen reduces oxides of metals that are more active than iron.

Choose the **most appropriate** answer from the options given below:

(1) B, D only

(2) D, E only

(3) A, B, C only

(4) B, C, D, E only

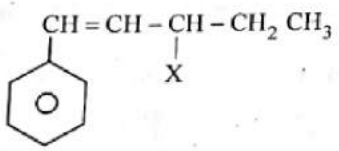
Answer (2)

Sol. Statement A, B, C are correct

(D) H – H bond dissociation energy is maximum as compared to single bond between two atom of any element.

(E) Hydrogen reduces oxides of metal that are less active than iron.

67. The given compound



is an example of _____.

(1) Aryl halide

(2) Allylic halide

(3) Vinylic halide

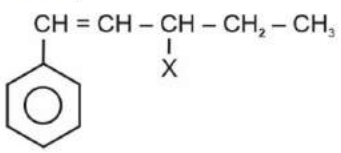
(4) Benzylic halide

Answer (2)

Sol. α-carbon is sp^3 carbon which is right next to $>C=C<$

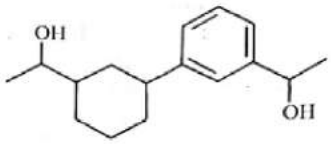
This α-position is known as allylic position

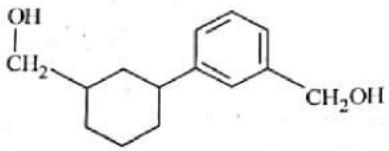
Hence,

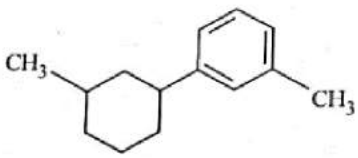


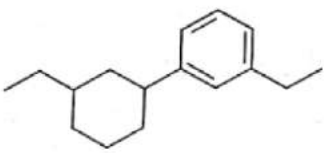
is allylic halide

68. Identify product (A) in the following reaction:

(1) 

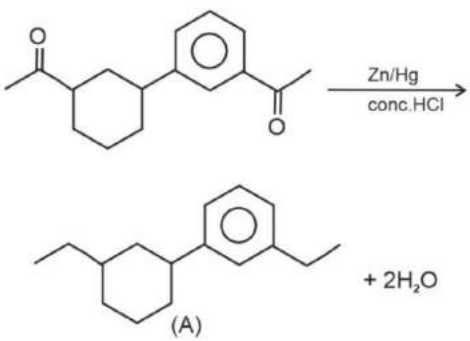
(2) 

(3) 

(4) 

Answer (4)

Sol. This reaction is Clemmensen reduction



69. The conductivity of centimolar solution of KCl at 25°C is 0.0210 ohm^{-1} cm^{-1} and the resistance of the cell containing the solution at 25°C is 60 ohm. The value of cell constant is

(1) 3.28 cm^{-1}

(2) 1.26 cm^{-1}

(3) 3.34 cm^{-1}

(4) 1.34 cm^{-1}

Answer (2)

Sol. Conductivity = conductance × cell constant

$k = G\,G^*$

$= \frac{1}{R} G^*$

$G^* = k \times R = 0.0210 \times 60 = 1.26\ cm^{-1}$

70. Amongst the given options which of the following molecules/ ion acts as a Lewis acid?

(1) H_2O

(2) BF_3

(3) OH^-

(4) NH_3

Answer (2)

Sol. Lewis acids are the one which accepts lone pair of electron due to presence of vacant orbital in outermost shell.

$H_2\ddot{O}: \longrightarrow$ Lewis base

$BF_3 \longrightarrow$ Lewis acid

$:\ddot{O}H \longrightarrow$ Lewis base

$\ddot{N}H_3 \longrightarrow$ Lewis base

71. Given below are two statements :

Statement I : A unit formed by the attachment of a base to 1′ position of sugar is known as nucleoside.

Statement II : When nucleoside is linked to phosphorous acid at 5′ -position of sugar moiety, we get nucleotide.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both Statement **I** and Statement **II** are false

(2) Statement **I** is true but Statement **II** is false

(3) Statement **I** is false but Statement **II** is true

(4) Both Statement **I** and Statement **II** are true

Answer (2)

Sol. A unit formed by the attachment of a base to 1′ position of sugar is known as **nucleoside**. In nucleosides, the sugar carbons are numbered as 1′, 2′, 3′, etc. in order to distinguish these from the bases (Fig.(a)). When nucleoside is linked to phosphoric acid at 5′ -position of sugar moiety, we get a nucleotide (Fig.(b)).

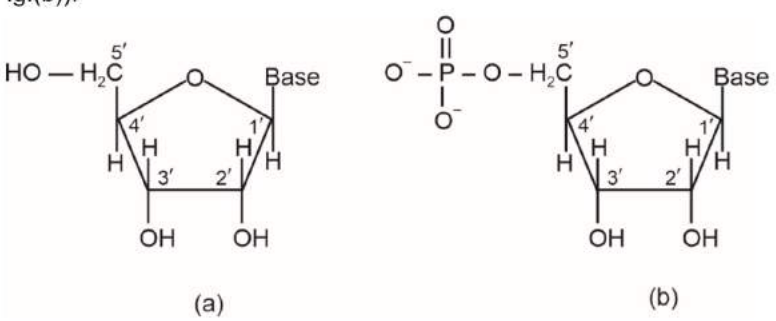


Fig. : Structure of (a) a nucleoside and (b) a nucleotide

72. The relation between n_m, (n_m = the number of permissible values of magnetic quantum number (m)) for a given value of azimuthal quantum number (l), is

(1) $l = 2n_m + 1$

(2) $n_m = 2l^2 + 1$

(3) $n_m = l + 2$

(4) $l = \frac{n_m - 1}{2}$

Answer (4)

Sol. Values of n_m(magnetic quantum number) for given azimuthal quantum number can be calculated as following

$n_m = 2l + 1$

$l = \frac{n_m - 1}{2}$

73. Amongst the following the total number of species NOT having eight electrons around central atom in its outermost shell, is

NH_3, $AlCl_3$, $BeCl_2$, CCl_4, PCl_5 :

(1) 2

(2) 4

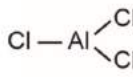
(3) 1

(4) 3

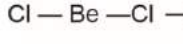
Answer (4)

Sol.

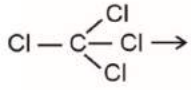
$\longrightarrow 8\,e^-$ in nitrogen



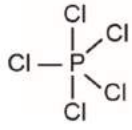
$\longrightarrow 6\,e^-$ in Al



$\longrightarrow 4\,e^-$ in Be



$\longrightarrow 8\,e^-$ in 'C'



$\longrightarrow 10\,e^-$ in 'P'

74. Intermolecular forces are forces of attraction and repulsion between interacting particles that will include :

A. dipole - dipole forces

B. dipole - induced dipole forces

C. hydrogen bonding

D. covalent bonding

E. dispersion forces

Choose the **most appropriate** answer from the options given below :

(1) A, B, C, D are correct

(2) A, B, C, E are correct

(3) A, C, D, E are correct

(4) B, C, D, E are correct

Answer (2)

Sol. Intermolecular forces are the forces of attraction and repulsion between interacting molecules. This term does not include covalent bonds as covalent bond holds atoms of a molecule together.

Hence, dipole - dipole forces, dipole - induced dipole forces, hydrogen bonding and dispersion forces are intermolecular forces.

75. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R** :

Assertion A : Metallic sodium dissolves in liquid ammonia giving a deep blue solution, which is paramagnetic.

Reason R : The deep blue solution is due to the formation of amide.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **A** and **R** are true but **R** is **NOT** the correct explanation of **A**

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

(4) Both **A** and **R** are true and **R** is the correct explanation of **A**

Answer (2)

Sol. On dissolving alkali metal (sodium) in liquid ammonia, a deep blue solution is developed due to ammoniated electron which absorbs energy in visible region of light and imparts blue colour. Due to unpaired electron, solution is paramagnetic.

$M + (x + y)NH_3 \rightarrow [M(NH_3)_x]^+ + [e(NH_3)y]^-$

So, assertion statement is correct but reason is incorrect.

76. The element expected to form largest ion to achieve the nearest noble gas configuration is

(1) F

(2) N

(3) Na

(4) O

Answer (2)

Sol. For isoelectronic species, as the charge on anion increases, ionic size increases

So, N forms N^{3-} anion with largest ionic size

77. Some tranquilizers are listed below. Which one from the following belongs to barbiturates?

(1) Meprobamate

(2) Valium

(3) Veronal

(4) Chlordiazepoxide

Answer (3)

Sol. Veronal is the derivative of Barbituric acid and considered as barbiturate.

Meprobamate, valium and chlordiazepoxide are other tranquilizers.

78. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**

Assertion A : In equation $\Delta_r G = -nFE_{cell}$, value of $\Delta_r G$ depends on n.

Reasons R : E_{cell} is an intensive property and $\Delta_r G$ is an extensive property.

In the light of the above statements, choose the **correct** answer from the options given below

(1) Both **A** and **R** are true and **R** is **NOT** the correct explanation of **A**

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

(4) Both **A** and **R** are true and **R** is the correct explanation of **A**

Answer (1)

Sol. The value of $\Delta_r G$ depends on n value as per the equation $\Delta_r G = -nFE_{cell}$

Where E is the emf of the cell and nF is the amount of charge passed.

So, assertion statement is correct

E_{cell} is an intensive property while $\Delta_r G$ is an extensive thermodynamic property

So, reason is correct but not explaining the assertion

79. Which amongst the following molecules on polymerization produces neoprene?

(1) $H_2C = \overset{\overset{Cl}{|}}{C} - CH = CH_2$

(2) $H_2C = CH - C \equiv CH$

(3) $H_2C = \overset{\overset{CH_3}{|}}{C} - CH = CH_2$

(4) $H_2C = CH - CH = CH_2$

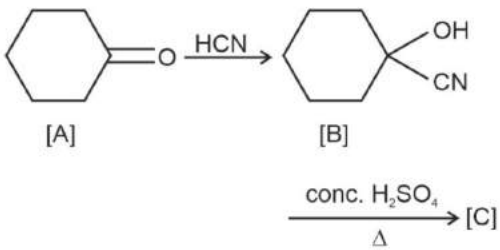
Answer (1)

Sol. Neoprene is formed by free radical polymerisation of chloroprene.

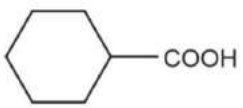
$$nCH_2 = \overset{\overset{Cl}{|}}{C} - CH = CH_2 \xrightarrow{\text{Polymerisation}} \left[CH_2 - \overset{\overset{Cl}{|}}{C} = CH - CH_2 \right]_n$$

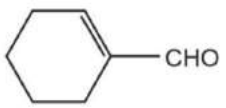
2-Chloro-1, 3-butadiene (Chloroprene) → Neoprene

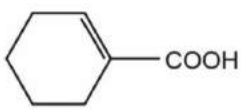
80. Complete the following reaction

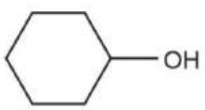


[C] is _____

(1) 

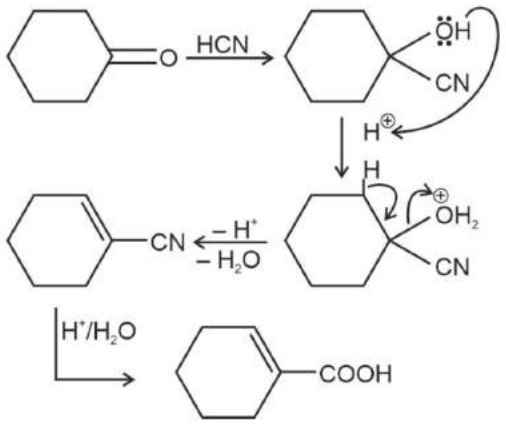
(2) 

(3) 

(4) 

Answer (3)

Sol.



81. Weight (g) of two moles of the organic compound, which is obtained by heating sodium ethanoate with sodium hydroxide in presence of calcium oxide is :

(1) 32

(2) 30

(3) 18

(4) 16

Answer (1)

Sol. This reaction is called soda lime decarboxylation

$$\underset{\text{Sodium ethanoate}}{CH_3-\underset{\underset{O}{\|}}{C}-O^-Na^+} \xrightarrow[CaO(s)]{NaOH} \underset{\text{Methane}}{CH_4(g)} + \underset{\text{Sodium carbonate}}{Na_2CO_3(s)}$$

Molar mass of CH_4 = 16 g/mol

Weight of 2 moles of CH_4 = 16 × 2

= 32 g

82. Which of the following reactions will NOT give primary amine as the product?

(1) $CH_3CN \xrightarrow[(ii)\ H_3O^{\oplus}]{(i)\ LiAlH_4}$ Product

(2) $CH_3NC \xrightarrow[(ii)\ H_3O^{\oplus}]{(i)\ LiAlH_4}$ Product

(3) $CH_3CONH_2 \xrightarrow[(ii)\ H_3O^{\oplus}]{(i)\ LiAlH_4}$ Product

(4) $CH_3CONH_2 \xrightarrow{Br_2/KOH}$ Product

Answer (2)

Sol. (1) $CH_3-C\equiv N \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } LiAlH_4} CH_3-CH_2-NH_2$

(Primary amine)

(2) $CH_3NC \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } LiAlH_4} CH_3-\overset{\overset{H}{|}}{N}-CH_3$

(Secondary amine)

(3) $CH_3-\overset{\overset{O}{||}}{C}-NH_2 \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } LiAlH_4} CH_3-CH_2-NH_2$

(Primary amine)

(4) $CH_3-\overset{\overset{O}{||}}{C}-NH_2 \xrightarrow[\text{Hoffmann bromamide degradation reaction}]{Br_2/KOH} CH_3-NH_2$ (Primary amine)

83. The right option for the mass of CO_2 produced by heating 20 g of 20% pure limestone is (Atomic mass of Ca = 40) $\left[CaCO_3 \xrightarrow{1200\text{ K}} CaO + CO_2\right]$

(1) 1.76 g

(2) 2.64 g

(3) 1.32 g

(4) 1.12 g

Answer (1)

Sol. $CaCO_3 \xrightarrow{1200\text{ K}} CaO + CO_2$

From 100 g $CaCO_3 \rightarrow$ 44 g CO_2 produced

As $CaCO_3$ is 20% pure

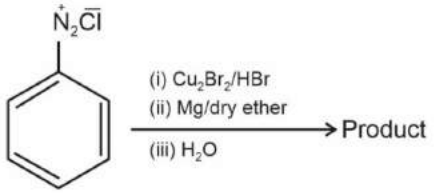
So, mass of pure $CaCO_3$ = $20 \times \frac{20}{100} = 4\text{g}$

So, 100 g $CaCO_3 \rightarrow$ 44 g CO_2

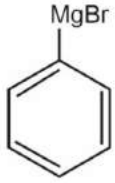
4 g $CaCO_3 \rightarrow \frac{44}{100} \times 4\text{g } CO_2$

= 1.76 g CO_2

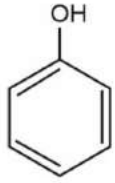
84. Identify the product in the following reaction:



(1)

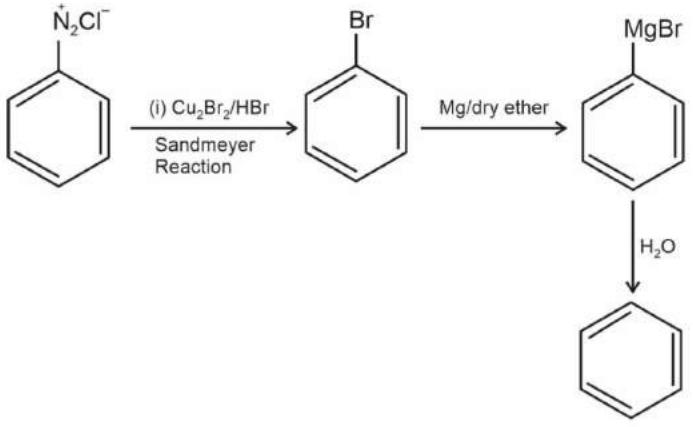
(2) 

(3)

(4) 

Answer (1)

Sol.



85. The number of σ bonds, π bonds and lone pair of electrons in pyridine, respectively are:

(1) 12, 3, 0

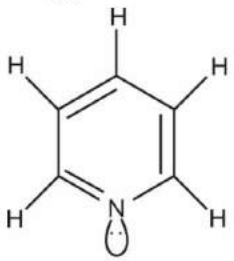
(2) 11, 3, 1

(3) 12, 2, 1

(4) 11, 2, 0

Answer (2)

Sol.



Pyridine

No. of σ bonds = 11

No. of π bonds = 3

No. of lone pair of e^- = 1

SECTION-B

86. Which amongst the following options is the **correct** relation between change in enthalpy and change in internal energy?

(1) $\Delta H = \Delta U + \Delta n_g RT$

(2) $\Delta H - \Delta U = -\Delta nRT$

(3) $\Delta H + \Delta U = \Delta nR$

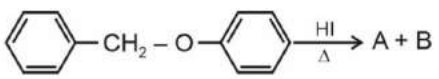
(4) $\Delta H = \Delta U - \Delta n_g RT$

Answer (1)

Sol. Correct relation between change in enthalpy and change in internal energy is

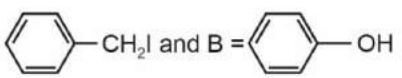
$\Delta H = \Delta U + \Delta n_g RT$

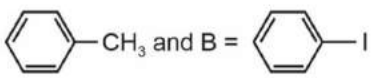
87. Consider the following reaction :



Identify products A and B.

(1) A = and B =

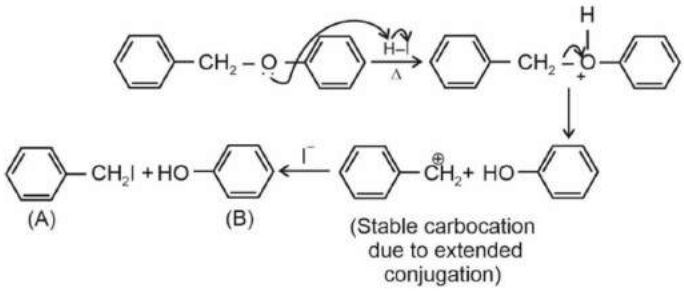
(2) A =  and B =

(3) A =  and B =

(4) A = and B =

Answer (2)

Sol.



88. Which of the following statements are **INCORRECT**?

A. All the transition metals except scandium form MO oxides which are ionic.

B. The highest oxidation number corresponding to the group number in transition metal oxides is attained in Sc_2O_3 to Mn_2O_7.

C. Basic character increases from V_2O_3 to V_2O_4 to V_2O_5.

D. V_2O_4 dissolves in acids to give VO_4^{3-} salts.

E. CrO is basic but Cr_2O_3 is amphoteric.

Choose the **correct** answer from the options given below:

(1) B and D only

(2) C and D only

(3) B and C only

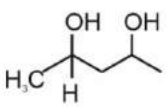
(4) A and E only

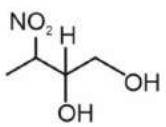
Answer (2)

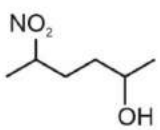
Sol. All transitions metals except Sc from MO oxides which are ionic.

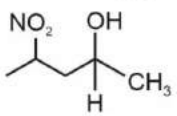
- The highest oxidation number corresponding to the group number in transition metal oxides in attained in Sc_2O_3 to Mn_2O_7.
- Acidic character increases from V_2O_3 to V_2O_4 to V_2O_5.
- V_2O_4 dissolves in acids to give VO^{2+}.
- CrO is basic but Cr_2O_3 is amphoteric.

89. Which amongst the following will be most readily dehydrated under acidic conditions?

(1) 

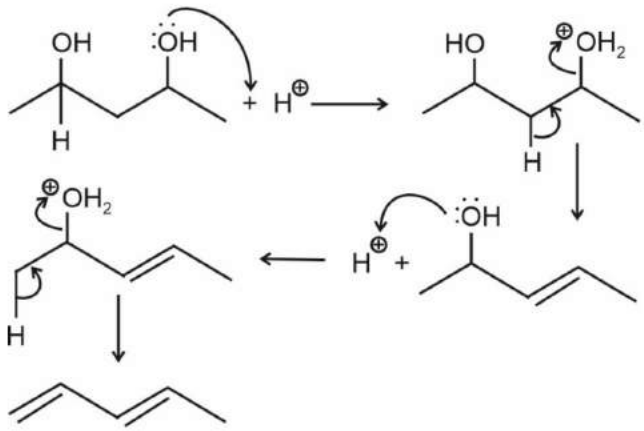
(2) 

(3) 

(4) 

Answer (1)

Sol.



90. The reaction that does **NOT** take place in a blast furnace between 900 K to 1500 K temperature range during extraction of iron is :

(1) $FeO + CO \rightarrow Fe + CO_2$

(2) $C + CO_2 \rightarrow 2CO$

(3) $CaO + SiO_2 \rightarrow CaSiO_3$

(4) $Fe_2O_3 + CO \rightarrow 2FeO + CO_2$

Answer (4)

Sol. At 900 -1500 K (higher temperature range in the blast furnace)

Reaction which take place are :–

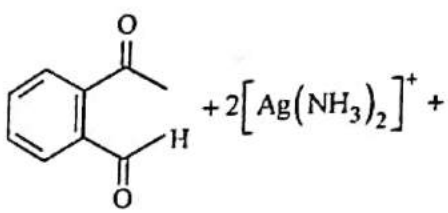
$C + CO_2 \rightarrow 2CO$

$FeO + CO \rightarrow Fe + CO_2$

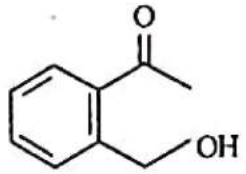
$CaO + SiO_2 \rightarrow CaSiO_3$ (Slag formation)

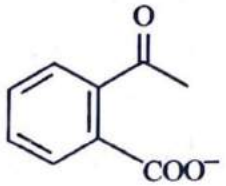
$Fe_2O_3 + CO \rightarrow 2FeO + CO_2 \rightarrow$ This take place at 500 - 800 K.

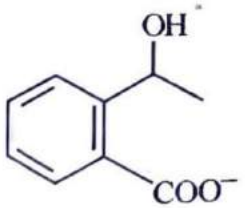
91. Identify the major product obtained in the following reaction:

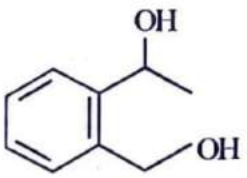


$3\,^{-}OH \xrightarrow{\Delta}$ major product

(1) 

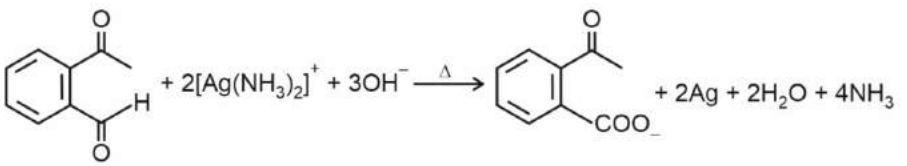
(2) 

(3) 

(4) 

Answer (2)

Sol. Ammoniacal silver nitrate solution is Tollens' reagent. Tollens' reagent can be used to distinguish aldehyde & ketone as aldehyde upon warming with Tollens' reagent produces a silver mirror due to formation of silver metal in alkaline medium. Aldehyde is oxidised to corresponding carboxylate anion.



92. What fraction of one edge centred octahedral void lies in one unit cell of fcc?

(1) $\frac{1}{3}$

(2) $\frac{1}{4}$

(3) $\frac{1}{12}$

(4) $\frac{1}{2}$

Answer (2)

Sol. The total number of octahedral voids in FCC are four

Octahedral voids in FCC = Edge centres + Body centre

The contribution of edge centre = $\frac{1}{4}$

$\therefore$ Fraction of one edge centred octahedral void in one unit cell of FCC = $\frac{1}{4}$

93. The equilibrium concentrations of the species in the reaction $A + B \rightleftharpoons C + D$ are 2, 3, 10 and 6 mol L^{-1}, respectively at 300 K. ΔG^{o} for the reaction is (R = 2 cal/mol K)

(1) –137.26 cal

(2) –1381.80 cal

(3) –13.73 cal

(4) 1372.60 cal

Answer (2)

Sol.

	$A + B \rightleftharpoons$		$C + D$	
at equilibrium	2	3	10	6

k_{eq} = [C] [D]/ [A] [B]

$k_{eq} = \frac{10 \times 6}{2 \times 3} = 10$

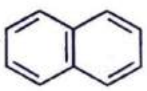
$\Delta G^{o} = -RT \ln K$

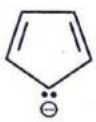
$= -2.303\ RT \log K$

$= -2.303 \times 2 \times 300 \times \log 10$

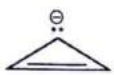
$= -1381.8$ cal

94. Consider the following compounds/species:

i. 

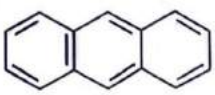
ii. 

iii.

iv. 

v.

vi.

vii. 

The number of compounds/species which obey Huckel's rule is _____.

(1) 6

(2) 2

(3) 5

(4) 4

Answer (4)

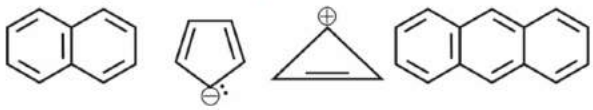
Sol. Criteria for Huckel's rule:

(i) Planarity

(ii) Complete delocalisation of π electrons

(iii) Presence of $(4n + 2)\pi$ electrons in ring where n is an integer (n = 0, 1, 2, ...)

The compounds which follow Huckel's rule are:



95. Which complex compound is most stable?

(1) $\left[Co(NH_3)_3(NO_3)_3\right]$

(2) $\left[CoCl_2(en)_2\right]NO_3$

(3) $\left[Co(NH_3)_6\right]_2(SO_4)_3$

(4) $\left[Co(NH_3)_4(H_2O)Br\right](NO_3)_2$

Answer (2)

Sol. Chelating ligands in general form more stable complexes than their monodentate analogs

$\therefore$ The most stable complex is

$\left[CoCl_2(en)_2\right]NO_3$

96. On balancing the given redox reaction,

$$aCr_2O_7^{2-} + bSO_3^{2-}(aq) + cH^+(aq) \rightarrow 2aCr^{3+}(aq) + bSO_4^{2-}(aq) + \frac{c}{2}H_2O(l)$$

the coefficients a, b and c are found to be, respectively-

(1) 3, 8, 1

(2) 1, 8, 3

(3) 8, 1, 3

(4) 1, 3, 8

Answer (4)

Sol. Using Ion electron method :

Reduction Half reaction : $Cr_2O_7^{2-} + 6e^- \longrightarrow 2Cr^{3+}$

Oxidation Half reaction : $SO_3^{2-} \longrightarrow SO_4^{2-} + 2\overline{e} \times 3$

Overall reaction : $Cr_2O_7^{2-} + 3SO_3^{2-} \longrightarrow 2Cr^{3+} + 3SO_4^{2-}$

- To balance 'O' atoms, adding H_2O on LHS

  $Cr_2O_7^{2-} + 3SO_3^{2-} \longrightarrow 2Cr^{3+} + 3SO_4^{2-} + 4H_2O$

- To balance 'H' atoms, adding H^+ on RHS

  $Cr_2O_7^{2-} + 3SO_3^{2-} + 8H^+ \longrightarrow 2Cr^{3+} + 3SO_4^{2-} + 4H_2O$

$\therefore$ a = 1

b = 3

c = 8

97. Given below are two statements :

Statement I : The nutrient deficient water bodies lead to eutrophication

Statement II : Eutrophication leads to decrease in the level of oxygen in the water bodies.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **Statement I** and **Statement II** are false.

(2) **Statement I** is correct but **Statement II** is false.

(3) **Statement I** is incorrect but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are true.

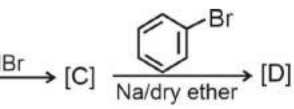
Answer (3)

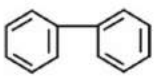
Sol. Nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity. This process is called as eutrophication.

98. Identify the final product [D] obtained in the following sequence of reactions.

$$CH_3CHO \xrightarrow[\text{ii) } H_3O^+]{\text{i) } LiAlH_4} [A] \xrightarrow[\Delta]{H_2SO_4} [B]$$

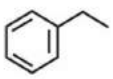
$$\xrightarrow{HBr} [C] \xrightarrow[\text{Na/dry ether}]{} [D]$$



(1) 

(2) C_4H_{10}

(3) $HC \equiv C^{\ominus}Na^{+}$

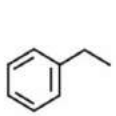
(4) 

Answer (4)

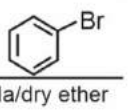
Sol. $CH_3CHO \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } LiAlH_4} CH_3CH_2OH \xrightarrow[\Delta]{H_2SO_4} CH_2{=}CH_2$

Reduction [A] Dehydration [B]

Bromination HBr



[D]



Na/dry ether

Wurtz-Fittig Reaction

$CH_3CH_2{-}Br$

[C]

99. Pumice stone is an example of

(1) Gel

(2) Solid sol

(3) Foam

(4) Sol

Answer (2)

Sol. Pumice stone is a solid sol.

Dispersed phase : Gas

Dispersed medium : Solid

100. Match **List-I** with **List-II** :

	List-I (Oxoacids of Sulphur)		**List-II (Bonds)**
A.	Peroxodisulphuric acid	I.	Two S–OH, Four S=O, One S–O–S
B.	Sulphuric acid	II.	Two S–OH, One S=O
C.	Pyrosulphuric acid	III.	Two S–OH, Four S=O, One S–O–O–S
D.	Sulphurous acid	IV.	Two S–OH, Two S=O

Choose the **correct** answer from the options given below.

(1) A–III, B–IV, C–I, D–II

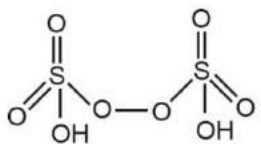
(2) A–I, B–III, C–IV, D–II

(3) A–III, B–IV, C–II, D–I

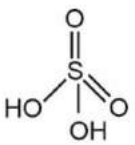
(4) A–I, B–III, C–II, D–IV

Answer (1)

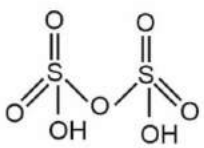
Sol.



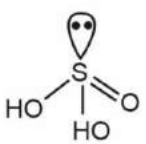
Peroxodisulphuric acid
($H_2S_2O_8$)



Sulphuric acid
(H_2SO_4)



Pyrosulphuric acid
($H_2S_2O_7$)



Sulphurous acid
(H_2SO_3)

BOTANY

SECTION-A

101. Which hormone promotes internode/petiole elongation in deep water rice?

(1) Kinetin

(2) Ethylene

(3) 2, 4-D

(4) GA_3

Answer (2)

Sol. Ethylene promotes rapid internode/petiole elongation in deep water rice plants.

102. Movement and accumulation of ions across a membrane against their concentration gradient can be explained by

(1) Facilitated Diffusion

(2) Passive Transport

(3) Active Transport

(4) Osmosis

Answer (3)

Sol. Movement and accumulation of ions across a membrane against their concentration gradient can be explained by active transport. It uses energy to transport molecules from lower concentration to a higher concentration.

103. Large, colourful, fragrant flowers with nectar are seen in

(1) Bird pollinated plants

(2) Bat pollinated plants

(3) Wind pollinated plants

(4) Insect pollinated plants

Answer (4)

Sol. Large, colourful, fragrant flowers with nectar attract biotic pollinators (insects), thus, they are seen in insect pollinated plants.

104. In tissue culture experiments, leaf mesophyll cells are put in a culture medium to form callus. This phenomenon may be called as

(1) Dedifferentiation

(2) Development

(3) Senescence

(4) Differentiation

Answer (1)

Sol. In tissue culture experiments, leaf mesophyll cells are put in a culture medium to form callus. This phenomenon may be called as dedifferentiation.

Dedifferentiation is a phenomenon by which the living differentiated plant cells, that by now have lost the capacity to divide can regain the capacity of division under certain conditions.

105. The historic Convention on Biological Diversity, 'The Earth Summit' was held in Rio de Janeiro in the year

(1) 1992

(2) 1986

(3) 2002

(4) 1985

Answer (1)

Sol. The historic convention on Biological Diversity, "The Earth Summit" was held in Rio de Janeiro in the year 1992. It called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

106. During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out

(1) DNA

(2) Histones

(3) Polysaccharides

(4) RNA

Answer (1)

Sol. Option (1) is the correct answer as, during isolation of the genetic material, purified DNA ultimately precipitates out after the addition of chilled ethanol.

Option (2) is not the answer as, proteins can be removed by treatment with proteases.

Option (4) is not the answer as RNA can be removed by treatment with ribonuclease.

107. How many ATP and $NADPH_2$ are required for the synthesis of one molecule of Glucose during Calvin cycle?

(1) 18 ATP and 12 $NADPH_2$

(2) 12 ATP and 16 $NADPH_2$

(3) 18 ATP and 16 $NADPH_2$

(4) 12 ATP and 12 $NADPH_2$

Answer (1)

Sol. For every CO_2 molecule entering the Calvin cycle, 3 molecules of ATP and 2 of $NADPH_2$ are required.

To make one molecule of glucose, 6 turns of the cycle are required. Thus, ATP and $NADPH_2$ molecules required for synthesis of one molecule of glucose during Calvin cycle will be

$$\rightarrow 6 \times \begin{bmatrix} 3ATP \\ 2NADPH_2 \end{bmatrix} = \begin{matrix} 18ATP \text{ and} \\ 12NADPH_2 \end{matrix}$$

108. In the equation $\boxed{GPP - R = NPP}$

GPP is Gross Primary Productivity

NPP is Net Primary Productivity

R here is _____.

(1) Respiratory quotient

(2) Respiratory loss

(3) Reproductive allocation

(4) Photosynthetically active radiation

Answer (2)

Sol. A considerable amount of GPP is utilised by plants in respiration. Gross primary productivity minus respiration losses (R), is the net primary productivity.

So R = Respiratory loss

109. In gene gun method used to introduce alien DNA into host cells, microparticles of _____ metal are used.

(1) Zinc

(2) Tungsten or gold

(3) Silver

(4) Copper

Answer (2)

Sol. Option (2) is the correct answer because in gene gun method, microparticles of tungsten or gold are used. Gold or tungsten are inert in nature so they do not alter the chemical composition of cells.

110. The phenomenon of pleiotropism refers to

(1) Presence of two alleles, each of the two genes controlling a single trait

(2) A single gene affecting multiple phenotypic expression

(3) More than two genes affecting a single character

(4) Presence of several alleles of a single gene controlling a single crossover

Answer (2)

Sol. When a single gene affects multiple phenotypic expression, the gene is called pleiotropic gene and the phenomenon is called pleiotropism.

111. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R** :

Assertion A : Late wood has fewer xylary elements with narrow vessels.

Reason R : Cambium is less active in winters.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

(4) Both **A** and **R** are true and **R** is the correct explanation of **A**

Answer (4)

Sol. In winter, the cambium is less active and forms fewer xylary elements that have narrow vessels, and this wood is called autumn wood or late wood.

112. Among eukaryotes, replication of DNA takes place in :

(1) S phase

(2) G_1 phase

(3) G_2 phase

(4) M phase

Answer (1)

Sol. Replication of DNA takes place in S-phase of cell cycle in eukaryotes. Most of the cell organelles duplicate in G_1 phase.

113. Family Fabaceae differs from Solanaceae and Liliaceae. With respect to the stamens, pick out the characteristics specific to family Fabaceae but not found in Solanaceae or Liliaceae.

(1) Polyadelphous and epipetalous stamens

(2) Monoadelphous and Monothecous anthers

(3) Epiphyllous and Dithecous anthers

(4) Diadelphous and Dithecous anthers

Answer (4)

Sol. Fabaceae $\rightarrow$ Diadelphous and dithecous anther.

Solanaceae $\rightarrow$ Polyandrous, epipetalous and dithecous anther.

Liliaceae $\rightarrow$ Polyandrous, epiphyllous and dithecous anther.

114. Axile placentation is observed in

(1) China rose, Beans and Lupin

(2) Tomato, Dianthus and Pea

(3) China rose, Petunia and Lemon

(4) Mustard, Cucumber and Primrose

Answer (3)

Sol. China rose, Tomato, *Petunia* and Lemon show axile placentation.

Dianthus and *Primrose* show free central placentation.

Pea, Lupin and Beans show marginal placentation.

Cucumber and mustard show parietal placentation.

115. Identify the pair of heterosporous pteridophytes among the following :

(1) *Selaginella* and *Salvinia*

(2) *Psilotum* and *Salvinia*

(3) *Equisetum* and *Salvinia*

(4) *Lycopodium* and *Selaginella*

Answer (1)

Sol. *Selaginella* and *Salvinia* are heterosporous pteridophytes. They produces two different kind of spores.

Psilotum, *Lycopodium* and *Equisetum* are homosporous pteridophytes.

116. The thickness of ozone in a column of air in the atmosphere is measured in terms of :

(1) Decibels

(2) Decameter

(3) Kilobase

(4) Dobson units

Answer (4)

Sol. The thickness of the ozone in a column of air from the ground to the top of the atmosphere is measured in terms of Dobson units (DU). Noise is measured in decibels.

117. What is the function of tassels in the corn cob?

(1) To trap pollen grains

(2) To disperse pollen grains

(3) To protect seeds

(4) To attract insects

Answer (1)

Sol. Tassels in the com cob represents stigma and style which wave in the wind to trap pollen grains.

118. Given below are two statements : One labelled as **Assertion A** and the other labelled as **Reason R**:

Assertion A : The first stage of gametophyte in the life cycle of moss is protonema stage.

Reason R : Protonema develops directly from spores produced in capsule.

In the light of the above statements, choose the **most appropriate** answer from options given below:

(1) Both **A** and **R** are correct but **R** is not the correct explanation of **A**

(2) **A** is correct but **R** is not correct

(3) **A** is not correct but **R** is correct

(4) Both **A** and **R** are correct and **R** is correct explanation of **A**

Answer (4)

Sol. The predominant stage of the life cycle of a moss is the gametophyte which consists of two stages. The first stage is the protonema stage, which develops directly from a spore. Capsule of the sporophyte contains spore which gives rise to protonema. Thus, reason correctly explains the assertion.

119. Given below are two statements :

Statement I : The forces generated transpiration can lift a xylem-sized column of water over 130 meters height.

Statement II : Transpiration cools leaf surfaces sometimes 10 to 15 degrees evaporative cooling.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) Both **Statement I** and **Statement II** are incorrect

(2) **Statement I** is correct but **Statement II** is incorrect

(3) **Statement I** is incorrect but **Statement II** is correct

(4) Both **Statement I** and **Statement II** are correct

Answer (4)

Sol. Statement I is correct as measurements reveal that the forces generated by transpiration can create pressures sufficient to lift a xylem sized column of water up to 130 meters high.

Statement II is also correct as transpiration cools leaf surfaces, sometimes 10 to 15 degrees, by evaporative cooling.

120. Spraying of which of the following phytohormone on juvenile conifers helps hastening the maturity period, that leads early seed production?

(1) Gibberellic Acid

(2) Zeatin

(3) Abscisic Acid

(4) Indole-3-butyric Acid

Answer (1)

Sol. Spraying juvenile conifers with gibberellins (GAs) hastens the maturity period, thus leading to early seed production.

121. Frequency of recombination between gene pairs on same chromosome as a measure of the distance between genes to map their position on chromosome, was used for the first time by

(1) Sutton and Boveri

(2) Alfred Sturtevant

(3) Henking

(4) Thomas Hunt Morgan

Answer (2)

Sol. Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on the chromosome.

Sutton and Boveri proposed chromosomal theory of inheritance.

Henking discovered X-chromosome.

Thomas Hunt Morgan proved chromosomal theory of inheritance and proposed the concept of linkage.

122. Expressed Sequence Tags (ESTs) refers to

(1) All genes that are expressed as proteins.

(2) All genes whether expressed or unexpressed.

(3) Certain important expressed genes.

(4) All genes that are expressed as RNA.

Answer (4)

Sol. All the genes that are expressed as RNA are referred to as Expressed Sequence Tags (ESTs).

123. Upon exposure to UV radiation, DNA stained with ethidium bromide will show

(1) Bright blue colour

(2) Bright yellow colour

(3) Bright orange colour

(4) Bright red colour

Answer (3)

Sol. Option (3) is the correct answer because in recombinant DNA technology the separated DNA fragments can be visualised only after staining the DNA with a substance known as ethidium bromide followed by exposure to U.V. radiation. You can see bright orange coloured bands of DNA in an ethidium bromide stained gel exposed to U.V. light.

124. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R :**

Assertion A : ATP is used at two steps in glycolysis.

Reason R : First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6-phosphate into fructose-1, 6-diphosphate.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.

(2) **A** is true but **R** is false.

(3) **A** is false but **R** is true.

(4) Both **A** and **R** are true and **R** is the correct explanation of **A**.

Answer (4)

Sol. ATP in glycolysis is used at two steps of conversion that are

Glucose $\rightarrow$ Glucose-6-phosphate

Fructose-6-phosphate $\rightarrow$ Fructose-1, 6-bisphosphate

The reason of the utilisation of ATP is for phosphorylation the substrates.

125. Unequivocal proof that DNA is the genetic material was first proposed by

(1) Alfred Hershey and Martha Chase

(2) Avery, Macleoid and McCarthy

(3) Wilkins and Franklin

(4) Frederick Griffith

Answer (1)

Sol. The unequivocal proof that DNA is the genetic material came from the experiment of Alfred Hershey and Martha Chase.

Avery, Macleoid and McCarty gave the biochemical characterisation of Transforming Principle.

The transformation experiments by using *Pneumococcus* was conducted by Frederick Griffith.

Wilkins and Franklin produced X-ray diffraction data of DNA.

126. Identify the **correct** statements:

A. Detrivores perform fragmentation.

B. The humus is further degraded by some microbes during mineralization.

C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.

D. The detritus food chain begins with living organisms.

E. Earthworms break down detritus into smaller particles by a process called catabolism.

Choose the **correct** answer from the options given below:

(1) B, C, D only

(2) C, D, E only

(3) D, E, A only

(4) A, B, C only

Answer (4)

Sol. The detritus food chain begins with detritus that is dead organic matter. The saprotrophic bacteria and fungi breakdown detritus into simpler inorganic substances by a process called catabolism.

127. The reaction centre in PS II has an absorption maxima at

(1) 700 nm

(2) 660 nm

(3) 780 nm

(4) 680 nm

Answer (4)

Sol. In PS-I, the reaction centre chlorophyll *a* has an absorption peak at 700 nm, while in PS-II, reaction centre has an absorption maxima at 680 nm.

128. In angiosperm, the haploid, diploid and triploid structures of a fertilized embryo sac sequentially are :

(1) Antipodals, synergids, and primary endosperm nucleus

(2) Synergids, Zygote and Primary endosperm nucleus

(3) Synergids, antipodals and Polar nuclei

(4) Synergids, Primary endosperm nucleus and zygote

Answer (2)

Sol. Synergids are the cells of gametophyte and hence these are haploid Zygote is formed by fusion of two gametes and thus it is diploid.

Primary endosperm nucleus is formed by the fusion of diploid secondary nucleus with a male gamete. Therefore, it is triploid.

129. Which micronutrient is required for splitting of water molecule during photosynthesis?

(1) Molybdenum

(2) Magnesium

(3) Copper

(4) Manganese

Answer (4)

Sol. Manganese plays a major role in the splitting of water to liberate oxygen during photosynthesis.

Copper is essential for the overall metabolism in plants.

Molybdenum is included in nitrogen metabolism.

Magnesium activates several enzymes involved in photosynthesis and respiration.

130. Which of the following stages of meiosis involves division of centromere?

(1) Metaphase II

(2) Anaphase II

(3) Telophase

(4) Metaphase I

Answer (2)

Sol. Splitting of centromere occurs during anaphase of mitosis or anaphase II of meiosis.

During Metaphase I and II, chromosomes align at the equator.

During telophase, chromosomes reach the respective poles.

131. Cellulose does not form blue colour with Iodine because

(1) It is a helical molecule

(2) It does not contain complex helices and hence cannot hold iodine molecules

(3) It breakes down when iodine reacts with it

(4) It is a disaccharide

Answer (2)

Sol. Option (2) is the correct answer because cellulose does not contain complex helices and hence cannot hold iodine molecules.

Option (1), (3) and (4) are not correct as cellulose is a polysaccharide.

132. Among 'The Evil Quartet', which one is considered the most important cause driving extinction of species?

(1) Over exploitation for economic gain

(2) Alien species invasions

(3) Co-extinctions

(4) Habitat loss and fragmentation

Answer (4)

Sol. Habitat loss and fragmentation is the most important cause driving animals and plants to extinction.

133. What is the role of RNA polymerase III in the process of transcription in Eukaryotes?

(1) Transcription of tRNA, 5S rRNA and snRNA

(2) Transcription of precursor of mRNA

(3) Transcription of only snRNAs

(4) Transcription of rRNAs (28S, 18S and 5.8S)

Answer (1)

Sol. In eukaryotes there are three major types of RNA polymerases.

RNA polymerase I transcribes : 5.8S, 18S, 28S rRNAs

RNA polymerase II transcribes : hnRNAs (precurssor of mRNA)

RNA polymerase III transcribes : tRNAs, ScRNA, 5S rRNA and snRNA

134. Given below are two statements :

Statement I : Endarch and exarch are the terms often used for describing the position of secondary xylem in the plant body.

Statement II : Exarch condition is the most common feature of the root system.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **Statement I** and **Statement II** are false

(2) **Statement I** is correct but **Statement II** is false

(3) **Statement I** is incorrect but **Statement II** is true

(4) Both **Statement I** and **Statement II** are true

Answer (3)

Sol. Endarch and exarch are the terms often used for describing the position of primary xylem in the plant body.

Primary xylem is of two types protoxylem and metaxylem. On the basis of relative position of protoxylem and metaxylem in the organ the arrangement of primary xylem can be endarch or exarch.

Exarch type of primary xylem is seen in roots. Therefore, Statement I is false and Statement II is true.

135. The process of appearance of recombination nodules occurs at which sub stage of prophase I in meiosis?

(1) Pachytene

(2) Diplotene

(3) Diakinesis

(4) Zygotene

Answer (1)

Sol. The process of recombination occurs at Pachytene stage of prophase I. This stage is characterised by the appearance of recombination nodules.

SECTION-B

136. Given below are two statements : One labelled as **Assertion A** and the other labelled as **Reason R :**

Assertion A : In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.

Reason R : Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **A** and **R** are true but **R** is NOT the current explanation of **A**

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

(4) Both **A** and **R** are true and **R** is the correct explanation of **A**

Answer (2)

Sol. Assertion is correct but reason is false as in gymnosperms the pollen grains are released from the microsporangium and they are carried in air currents. They come in contact with the opening of the ovules borne on megasporophylls. The *pollen tube* carrying the male gametes grows towards archegonia in the ovules and discharge their contents near the mouth of the archegonia.

137. Which one of the following statements is **NOT** correct?

(1) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries

(2) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body

(3) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels

(4) The micro-organisms involved in biodegradation of organic matter in a sewage polluted water body consume a lot of oxygen causing the death of aquatic organisms

Answer (1)

Sol. Algal bloom imparts a distinct colour to the water bodies. It causes deterioration of the water quantity and fish mortality.

138. Which of the following combinations is required for chemiosmosis?

(1) Membrane, proton pump, proton gradient, NADP synthase

(2) Proton pump, electron gradient, ATP synthase

(3) Proton pump, electron gradient, NADP synthase

(4) Membrane, proton pump, proton gradient, ATP synthase

Answer (4)

Sol. Chemiosmosis requires a membrane, a proton pump, a proton gradient and ATP synthase.

139. Match **List I** with **List II** :

	List I		**List II**
A.	M Phase	I.	Proteins are synthesized
B.	G_2 Phase	II.	Inactive phase
C.	Quiescent stage	III.	Interval between mitosis and initiation of DNA replication
D.	G_1 Phase	IV.	Equational division

Choose the correct answer from the options given below :

(1) A-IV, B-II, C-I, D-III

(2) A-IV, B-I, C-II, D-III

(3) A-II, B-IV, C-I, D-III

(4) A-III, B-II, C-IV, D-I

Answer (2)

Sol. M phase or mitosis is the phase where the actual cell division occurs. Mitosis is also called equational division.

During G_2 phase DNA synthesis stops but cell synthesis RNA, proteins, etc. for next phase.

Quiescent stage is inactive phase in which non-dividing cells enters.

G_1 phase is the interval between mitosis and initiation of DNA replication.

Therefore, option (2) is correct.

140. Match **List I** with **List II** :

	List I (Interaction)		**List II (Species A and B)**
A.	Mutualism	I.	+(A), 0(B)
B.	Commensalism	II.	–(A), 0(B)
C.	Amensalism	III.	+(A), –(B)
D.	Parasitism	IV.	+(A), +(B)

Choose the **correct** answer from the options given below:

(1) A-IV, B-I, C-II, D-III

(2) A-IV, B-III, C-I, D-II

(3) A-III, B-I, C-IV, D-II

(4) A-IV, B-II, C-I, D-III

Answer (1)

Sol. (+, +) Mutualism : In this interaction, both the interacting species are benefitted.

(+, 0) Commensalism : Only one species is benefitted and the other species remains unharmed.

(–, 0) Amensalism : Neither species is benefitted. One remains unharmed and the other is harmed.

(+, –) Parasitism : One species is benefitted and other is negatively effected.

141. Given below are two statements:

Statement I : Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and competitively inferior one will be eliminated eventually.

Statement II : In general, carnivores are more adversely affected by competition than herbivores.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **Statement I** and **Statement II** are false.

(2) **Statement I** is correct **Statement II** is false.

(3) **Statement I** is incorrec but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are true.

Answer (2)

Sol. Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventaully. Thus, statement I is correct.

Statement II is incorrect as in general, herbivores and plants appear to be more adversely affected by competition than carnivores.

142. Match **List I** with **List II**:

	List I		**List II**
A.	Iron	I.	Synthesis of auxin
B.	Zinc	II.	Component of nitrate reductase
C.	Boron	III.	Activator of catalase
D.	Molybdenum	IV.	Cell elongation and differentiation

Choos the correct answer from the options given below:

(1) A-II, B-III, C-IV, D-I

(2) A-III, B-I, C-IV, D-II

(3) A-II, B-IV, C-I, D-III

(4) A-III, B-II, C-I, D-IV

Answer (2)

Sol. Iron activates catalase enzyme.

Zinc is needed in the synthesis of auxin.

Boron is required for cell elongation and cell differentiation.

Molybdenum is component of nitrogenase and nitrate reductase enzyme.

Therefore, option (2) is correct.

143. Which of the following statements are correct about Klinefelter's Syndrome?

A. This disorder was first described by Langdon Down (1866).

B. Such an individual has overall masculine development. However, the feminine developement is also expressed.

C. The affected individual is short statured.

D. Physical, psychomotor and mental development is retarded.

E. Such individuals are sterile.

Choose the **correct** answer from the options given below:

(1) C and D only

(2) B and E only

(3) A and E only

(4) A and B only

Answer (2)

Sol. Klinefelter's syndrome is caused due to the presence of an additional copy of X-chromosome resulting into a karyotype of 47, XXY. Such an individual has overall masculine development, however, the feminine development is also expressed. Such individuals are sterile. Thus, statement B and E are correct regarding Klinefelter's syndrome.

Statement A, C and D are incorrect w.r.t. Klinefelter's syndrome as they are associated with Down's syndrome.

144. Identify the **correct** statements:

A. Lenticels are the lens-shaped openings permitting the exchange of gases.

B. Bark formed early in the season is called hard bark.

C. Bark is a technical term that refers to all tissues exterior to vascular cambium.

D. Bark refers to periderm and secondary phloem.

E. Phellogen is single-layered in thickness.

Choose the correct answer from the options given below:

(1) A and D only

(2) A, B and D only

(3) B and C only

(4) B, C and E only

Answer (1)

Sol. Lenticels are lens shaped opening permitting exchange of gases between the outer atmosphere and internal tissue of the stem.

Bark that is formed early in the season is called early or soft bark. Towards the end of the season late or hard bark is formed.

Bark is non-technical term that refer to all tissues exterior to vascular cambium.

Bark refers to a number of tissue types, viz periderm and secondary phloem.

Phellogen is couple of layers thick

Therefore, only statement A and D are correct.

145. How many different proteins does the ribosome consist of?

(1) 60

(2) 40

(3) 20

(4) 80

Answer (4)

Sol. The ribosome consists of structural RNAs and about 80 different proteins.

146. Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of

(1) Amylase

(2) Lipase

(3) Dinitrogenase

(4) Succinic dehydrogenase

Answer (4)

Sol. Option (4) is correct answer of this question because malonate is a competitive inhibitor of enzyme succinate dehydrogenase.

Inhibition of succinic dehydrogenase by malonate occurs due to close resemblance of malonate with substrate succinate in structure. Competitive inhibitors are often used in the control of bacterial pathogens.

147. Match **List I** with **List II** :

	List I		**List II**
A.	Cohesion	I.	More attraction in liquid phase
B.	Adhesion	II.	Mutual attraction among water molecules
C.	Surface tension	III.	Water loss in liquid phase
D.	Guttation	IV.	Attraction towards polar surfaces

Choose the **correct** answer from the options given below :

(1) A – IV, B – III, C – II, D – I

(2) A – III, B – I, C – IV, D – II

(3) A – II, B – I, C – IV, D – III

(4) A – II, B – IV, C – I, D – III

Answer (4)

Sol. Cohesion represents mutual attraction between water molecules. Adhesion represents attraction of water molecules to polar surfaces Surface tension represents water molecules are attracted to each other in the liquid phase more than to water in the gas phase. Guttation represent loss of water in liquid phase.

Thus, option (4) is correct.

148. Match **List I** with **List II** :

	List I		**List II**
A.	Oxidative decarboxylation	I.	Citrate synthase
B.	Glycolysis	II.	Pyruvate dehydrogenase
C.	Oxidative phosphorylation	III.	Electron transport system
D.	Tricarboxylic acid cycle	IV.	EMP pathway

Choose the correct answer from the options given below :

(1) A – II, B – IV, C – I, D – III

(2) A – III, B – I, C – II, D – IV

(3) A – II, B – IV, C – III, D – I

(4) A – III, B – IV, C – II, D – I

Answer (3)

Sol. Pyruvate, which is formed by the glycolytic catabolism of carbohydrates in the cytosol, after it enters mitochondrial matrix undergoes oxidative decarboxylation by a complex set of reactions catalyzed by pyruvate dehydrogenase.

The scheme of glycolysis was given by Gustav Embden, Otto Meyrhof and J. Parnas, and is often referred to as the EMP pathway.

In electron transport system, the energy of oxidation-reduction is utilized for the production of proton gradient required for phosphorylation, thus, this process is also called oxidative phosphorylation.

The TCA (tricarboxylic acid cycle) starts with the condensation of acetyl group with oxaloacetic acid (OAA) and water to yield citric acid. The reaction is catalysed by the enzyme citrate synthase. Thus, option (3) is correct.

149. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R :**

Assertion A : A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem.

Reason R : Internode of the shoot gets condensed to produce different floral appendages laterally at successive node instead of leaves.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

(4) Both **A** and **R** are true and **R** correct explanation of **A**

Answer (4)

Sol. A flower is a modified shoot wherein the shoot apical meristem changes to floral meristem.

Internodes do not elongate and the axis gets condensed. The apex produces different kinds of floral appendages laterally at the successive nodes instead of leaves.

Therefore, both **A** and **R** are true and **R** is correct explanation of **A**.

150. Main steps in the formation of Recombinant DNA are given below. Arrange these steps in a correct sequence.

A Insertion of recombinant DNA into the host cell

B Cutting of DNA at specific location by restriction enzyme

C Isolation of desired DNA fragment

D Amplification of gene of interest using PCR

Choose the correct answer from the options given below :

(1) C, A, B, D

(2) C, B, D, A

(3) B, D, A, C

(4) B, C, D, A

Answer (4)

Sol. The correct answer is option (4) because recombinant DNA technology involves several steps in specific sequence such as isolation of DNA, fragmentation of DNA by restriction endonucleases, isolation of desired DNA fragment, ligation of the DNA fragment into a vector, transferring the recombinant DNA into the host, culturing the host cells in a medium at large scale and extraction of the desired product.

ZOOLOGY

SECTION-A

151. Which of the following statements are correct regarding female reproductive cycle?

A. In non-primate mammals cyclical changes during reproduction are called oestrus cycle.

B. First menstrual cycle begins at puberty and is called menopause.

C. Lack of menstruation may be indicative of pregnancy.

D. Cyclic menstruation extends between menarche and menopause.

Choose the **most appropriate** answer from the options given below.

(1) A and B only

(2) A, B and C only

(3) A, C and D only

(4) A and D only

Answer (3)

Sol. The correct answer is option (3) as first menstrual cycle that begins at puberty is called menarche.

Cyclic menstruation is an indicator of normal reproductive phase and extends between menarche and menopause.

In primates, cyclical changes during reproduction are called menstrual cycle.

152. Given below are two statements: one is labelled as **Assertion A** and other is labelled as **Reason R**.

Assertion A : Amniocentesis for sex determination is one of the strategies of Reproductive and Child Health Care Programme.

Reason R : Ban on amniocentesis checks increasing menace of female foeticide.

In the light of the above statements, choose the **correct** answer from the options given below.

(1) Both **A** and **R** are true and **R** is NOT the correct explanation of **A**.

(2) **A** is true but **R** is false.

(3) **A** is false but **R** is true.

(4) Both **A** and **R** are true and **R** is the correct explanation of **A**.

Answer (3)

Sol. The correct answer is option (3) as 'Reproductive and Child Health Care (RCH) programme' deals with creating awareness among people about various reproduction related aspects and providing facilities and support for building up a reproductively healthy society.

Amniocentesis is basically used to test for the presence of certain genetic disorders such as Down's syndrome, haemophilia, *etc*., to determine the survivability of the foetus.

Amniocentesis is not a sex determination technique in India and is not a strategy of RCH.

153. Match **List I** with **List II**.

	List I (Interacting species)		**List II (Name of interaction)**
A.	A Leopard and a Lion in a forest/grassland	I.	Competition
B.	A Cuckoo laying egg in a Crow's nest	II.	Brood parasitism
C.	Fungi and root of a higher plant in Mycorrhizae	III.	Mutualism
D.	A cattle egret and a Cattle in a field	IV.	Commensalism

Choose the **correct** answer from the options given below.

(1) A-I, B-II, C-IV, D-III

(2) A-III, B-IV, C-I, D-II

(3) A-II, B-III, C-I, D-IV

(4) A-I, B-II, C-III, D-IV

Answer (4)

Sol. A leopard and a lion in a forest/grassland exemplify competition where both the species are competing for the same resources.

A cuckoo laying egg in a crow's nest is brood parasitism where cuckoo is the parasitic bird that lays its egg in the nest of crow (host bird).

Fungi and root of a higher plant in mycorrhizae exemplify mutualism where both the species are benefitted. The fungi help the plant in the absorption of essential nutrients from the soil while the plant in turn provides the fungi with energy yielding carbohydrates.

A cattle egret and a cattle in a field exemplify commensalism where one species benefits and the other remains unaffected.

The egrets always forage close to where cattle are grazing because the cattle, as they move, stir up and flush out insects from the vegetation that otherwise might be difficult for the egrets to find and catch.

154. Vital capacity of lung is _____.

(1) IRV + ERV + TV + RV

(2) IRV + ERV + TV – RV

(3) IRV + ERV + TV

(4) IRV + ERV

Answer (3)

Sol. Option (3) is the correct answer because vital capacity is the maximum volume of air a person can breathe in after forced expiration. This includes ERV, TV and IRV.

155. Which one of the following common sexually transmitted diseases is completely curable when detected early and treated properly?

(1) Gonorrhoea

(2) Hepatitis-B

(3) HIV Infection

(4) Genital herpes

Answer (1)

Sol. The correct answer is option (1) because except for hepatitis-B, genital herpes and HIV infection other STIs are completely curable if detected early and treated properly.

Gonorrhoea is a bacterial disease which can be treated and cured completely, other diseases mentioned are viral diseases.

156. Match **List I** with **List II**.

	List I		**List II**
A.	CCK	I.	Kidney
B.	GIP	II.	Heart
C.	ANF	III.	Gastric gland
D.	ADH	IV.	Pancreas

Choose the **correct** answer from the options given below :

(1) A-III, B-II, C-IV, D-I

(2) A-II, B-IV, C-I, D-III

(3) A-IV, B-II, C-III, D-I

(4) A-IV, B-III, C-II, D-I

Answer (4)

Sol. The correct answer is option (4) as

- Cholecystokinin (CCK) acts on both gall bladder and pancreas and stimulates the secretion of bile juice and pancreatic enzymes respectively.
- GIP inhibits gastric secretion and motility.
- Atrial Natriuretic Factor (ANF) is released from the atrial wall of our heart.
- Anti-diuretic hormone (ADH) acts mainly on the kidney and stimulates resorption of water and electrolytes by the distal tubules.

157. Match **List I** with **List II**.

	List I		**List II**
A.	Ringworm	I.	*Haemophilus influenzae*
B.	Filariasis	II.	*Trichophyton*
C.	Malaria	III.	*Wuchereria bancrofti*
D.	Pneumonia	IV.	*Plasmodium vivax*

Choose the **correct** answer from the options given below:

(1) A-II, B-III, C-I, D-IV

(2) A-III, B-II, C-I, D-IV

(3) A-III, B-II, C-IV, D-I

(4) A-II, B-III, C-IV, D-I

Answer (4)

Sol. Option (4) is the correct answer because:

(i) Ringworm is caused by *Trichophyton.*

(ii) Filariasis is caused by *Wuchereria bancrofti.*

(iii) Malaria is caused by *Plasmodium species.*

(iv) Pneumonia is caused by *Haemophilus influenzae.*

158. Match **List I** with **List II**.

	List I		List II
A.	P-wave	I.	Beginning of systole
B.	Q-wave	II.	Repolarisation of ventricles
C.	QRS complex	III.	Depolarisation of atria
D.	T-wave	IV.	Depolarisation of ventricles

Choose the **correct** answer from the options given below :

(1) A-IV, B-III, C-II, D-I

(2) A-II, B-IV, C-I, D-III

(3) A-I, B-II, C-III, D-IV

(4) A-III, B-I, C-IV, D-II

Answer (4)

Sol. The correct answer is option (4) as in a standard ECG, P-wave represents the electrical excitation (or depolarisation) of the atria which leads to the contraction of both the atria.

- QRS complex represents the depolarisation of ventricles which initiates the ventricular contraction.
- T-wave represents the return of the ventricles from excited to normal state.

159. In which blood corpuscles, the HIV undergoes replication and produces progeny viruses?

(1) B-lymphocytes (2) Basophils

(3) Eosinophils (4) T_H cells

Answer (4)

Sol. The correct answer is option (4) because HIV enters into helper T-lymphocytes (T_H), replicates and produces progeny viruses. The progeny viruses released into blood attack other helper lymphocytes.

160. Given below are two statements :

Statement I : Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

Statement II : When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, it is known as competitive inhibitor.

In the light of the above statements, choose the correct answer from the options given below :

(1) Both **Statement I** and **Statement II** are false.

(2) **Statement I** is true but **Statement II** is flase.

(3) **Statement I** is false but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are true.

Answer (4)

Sol. The correct answer is option (4) as low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

- Competitive inhibitor due to its close structural similarity with the substrate, competes with the substrate for the substrate-binding site of the enzyme.

161. Given below are two statements:

Statement I: Ligaments are dense irregular tissue.

Statement II: Cartilage is dense regular tissue.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **Statement I** and **Statement II** are false

(2) **Statement I** is true but **Statement II** is false

(3) **Statement I** is false but **Statement II** is true

(4) Both **Statement I** and **Statement II** are true

Answer (1)

Sol. Option (1) is the correct answer because ligament is an example of dense regular connective tissue so Statement I is incorrect and cartilage is an example of specialised connective tissue and not dense regular tissue. Therefore Statement II is also incorrect.

162. Which of the following are NOT considered as the part of endomembrane system?

A. Mitochondria

B. Endoplasmic reticulum

C. Chloroplasts

D. Golgi complex

E. Peroxisomes

Choose the **most appropriate** answer from the options given below:

(1) A, C and E only

(2) A and D only

(3) A, D and E only

(4) B and D only

Answer (1)

Sol. The endomembrane system include endoplasmic reticulum (ER), golgi complex, lysosomes and vacuoles.

Since the functions of the mitochondria, chloroplast and peroxisomes are not coordinated with the above components, these are not considered as part of endomembrane system.

163. Given below are two statements:

Statement I: A protein is imagined as a line, the left end represented by first amino acid (C-terminal) and the right end represented by last amino acid (N-terminal).

Statement II: Adult human haemoglobin, consists of 4 subunits (two subunits of α type and two subunits of β type.)

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **Statement I** and **Statement II** are false.

(2) **Statement I** is true but **Statement II** is false.

(3) **Statement I** is false but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are true

Answer (3)

Sol. The correct answer is option (3) as a protein is imagined as a line, the left end represented by the first amino acid and the right end is represented by the last amino acid. The first amino acid is also called N-terminal amino acid. The last amino acid is called the C-terminal amino acid.

164. Broad palm with single palm crease is visible in a person suffering from-

(1) Turner's syndrome
(2) Klinefelter's syndrome
(3) Thalassemia
(4) Down's syndrome

Answer (4)

Sol. Down's syndrome is caused by an additional copy of chromosome number 21. Its symptoms include–

a. Broad palm with characteristic palm crease

b. Short statured with small round head

c. Furrowed tongue and partially open mouth, etc.

165. Which of the follwoing statements is correct?

(1) Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.
(2) Presence of large amount of nutrients in water restricts 'Algal Bloom'
(3) Algal Bloom decreases fish mortality
(4) Eutrophication refers to increase in domestic sewage and waste water in lakes.

Answer (1)

Sol. Increase in the concentration of the toxicant at successive trophic level is called biomagnification.

Large amount of nutrients in water promotes growth of algal bloom. Algal bloom increases fish mortality.

Eutrophication refers to the natural aging of a lake by nutrient enrichment of its water.

166. Match **List I** with **List II.**

	List I		**List II**
A.	*Taenia*	I.	Nephridia
B.	*Paramoecium*	II.	Contractile vacuole
C.	*Periplaneta*	III.	Flame cells
D.	*Pheretima*	IV.	Urecose gland

Choose the **correct** answer from the options given below:

(1) A-I, B-II, C-IV, D-III
(2) A-III, B-II, C-IV, D-I
(3) A-II, B-I, C-IV, D-III
(4) A-I, B-II, C-III, D-IV

Answer (2)

Sol. Option (2) is the correct answer because protonephridia or flame cells are the excretory structures in platyhelminthes. Nephridia are the tubular excretory structures of earthworms (*Pheretima*) and other annelids. Single celled organisms like *Paramoecium* have contractile vacuoles for excretion. Urecose glands .are present in cockroach

167. Given below are two statements:

Statement I:.Electrostatic precipitator is most widely used in thermal power plant

.**Statement II :** Electrostatic precipitator in thermal power plant removes ionising radiations

In the light of the above statements, choose the ***most appropriate*** answer from the options given below:

(1) Both **Statement I** and **Statement II** are incorrect.

(2) **Statement I** is correct but **Statement II** is incorrect.

(3) **Statement I** is incorrect but **Statement II** is correct.

(4) Both **Statement I** and **Statement II** are correct.

Answer (2)

Sol. .Electrostatic precipitator is most widely used in thermal power plants

It can remove over 99 percent particulate matter present in the exhaust from a thermal power plant.

168. Given below are two statements:

Statement I: Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

Statement II: The cavity of the cervix is called cervical canal which along with vagina forms birth canal.

In the light of the above statements, choose the correct answer from the options given below:

(1) Both **Statement I** and **Statement II** are false.

(2) **Statement I** is correct but **Statement II** is false.

(3) **Statement I** is incorrect but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are true.

Answer (4)

Sol. Option (4) is the correct answer to this question because statement I and statement II both are correct. Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct. The cavity of cervix is called cervical canal which along with vagina forms the birth canal.

169. Radial symmetry is NOT found in adults of phylum _____.

(1) Hemichordata (2) Coelenterata

(3) Echinodermata (4) Ctenophora

Answer (1)

Sol. Option (1) is the correct answer because hemichrodates are bilaterally symmetrical animals.

Option (2) is not the answer because coelenterates are radially symmetrical organisms.

.Option (3) is not the answer because adult echinoderms are radially symmetrical in adult stag

Option (4) is not the answer because ctenophores are radially symmetrical organisms.

170. Match **List I** with **List II**

List I (Cells)	**List II (Secretion)**
A. Peptic cells	I. Mucus
B. Goblet cells	II. Bile juice
C. Oxyntic cells	III. Proenzyme pepsinogen
D. Hepatic cells	IV. HCl and intrinsic factor for absorption of vitamin B_{12}

Choose the **correct** answer from the options given below:

(1) A-II, B-I, C-III, D-IV

(2) A-III, B-I, C-IV, D-II

(3) A-II, B-IV, C-I, D-III

(4) A-IV, B-III, C-II, D-I

Answer (2)

Sol. -Option (2) is the correct answer because gastric glands have three major types of cells namely

(i) Mucus neck cells which secrete mucus

(ii) Peptic or chief cells which secrete the proenzyme pepsinogen

Parietal or oxyntic cells which secrete HCl and intrinsic factor for absorption of vitamin B_{12}.

171. Match **List I** with **List II** with respect to human eye.

	List I		**List II**
A.	Fovea	I.	Visible coloured portion of eye that regulates diameter of pupil.
B.	Iris	II.	External layer of eye formed of dense connective tissue.
C.	Blind spot	III.	Point of greatest visual acuity or resolution.
D.	Sclera	IV.	Point where optic nerve leaves the eyeball and photoreceptor cells are absent.

Choose the **correct** answer from the options given below:

(1) A-IV, B-III, C-II, D-I

(2) A-I, B-IV, C-III, D-II

(3) A-II, B-I, C-III, D-IV

(4) A-III, B-I, C-IV, D-II

Answer (4)

Sol. Option (4) is the correct answer because

(i) Fovea is the point of greatest visual acuity or resolution.

(ii) Iris is the visible coloured portion of the eye that regulates diameter of pupil.

(iii) Blind spot is the point where optic nerve leaves the eye-ball and photoreceptor cells are absent.

(iv) Sclera is the external layer of eye formed of dense connective tissue.

172. Which of the following functions is carried out by cytoskeleton in a cell?

(1) Protein synthesis

(2) Motility

(3) Transportation

(4) Nuclear division

Answer (2)

Sol. An elaborate network of filamentous proteinaceous structures consisting of microtubules, microfilaments and intermediate filaments present in cytoplasm is collectively referred to as the cytoskeleton. It is involved in many functions such as mechanical support, motility, maintenance of the shape of the cell.

173. Once the undigested and unabsorbed substances enter the caecum, their backflow is prevented by

(1) Ileo-caecal valve

(2) Gastro-oesophageal sphincter

(3) Pyloric sphincter

(4) Sphincter of Oddi

Answer (1)

Sol. Option (1) is the correct answer because the undigested food (faeces) enters into caecum of the large intestine through ileo-caecal valve, which prevents the backflow of the faecal matter.

Option (2) is not the answer because a muscular sphincter i.e., the gastro-oesophageal sphincter regulates the opening of oesophagus into the stomach.

Option (3) is not the answer because pyloric sphincter regulates the opening in between stomach and duodenum.

Option (4) is not the answer because the opening of common hepato-pancreatic duct is guarded by sphincter of Oddi.

174. Match **List I** with **List II.**

	List I		**List II**
A.	Vasectomy	I.	Oral method
B.	Coitus interruptus	II.	Barrier method
C.	Cervical caps	III.	Surgical method
D.	Saheli	IV.	Natural method

Choose the **correct** answer from the options given below:

(1) A-III, B-IV, C-II, D-I

(2) A-II, B-III, C-I, D-IV

(3) A-IV, B-II, C-I, D-III

(4) A-III, B-I, C-IV, D-II

Answer (1)

Sol. Option (1) the correct answer because

(i) Vasectomy is a surgical method of contraception

(ii) Coitus interruptus is a natural method of contraception

(iii) Cervical cap is a barrier method of contraception

(iv) Saheli is an oral method of contraception which is a non-steroidal pill

175. Match **List I** with **List II.**

	List I (Type of Joint)		**List II (Found between)**
A.	Cartilaginous Joint	I.	Between flat skull bones
B.	Ball and Socket Joint	II.	Between adjacent vertebrae in vertebral column
C.	Fibrous Joint	III.	Between carpal and metacarpal of thumb
D.	Saddle Joint	IV.	Between Humerus and Pectoral girdle

Choose the **correct** answer from the options given below:

(1) A-II, B-IV, C-I, D-III

(2) A-I, B-IV, C-III, D-II

(3) A-II, B-IV, C-III, D-I

(4) A-III, B-I, C-II, D-IV

Answer (1)

Sol. Option (1) is the correct answer because cartilaginous joint is present in between the adjacent vertebrae in the vertebral column.

Option (2) is not the answer because cartilaginous joint is not present between flat skull bones.

Option (3) is not the answer because fibrous joint is not present in between the carpal and metacarpal of thumb.

Option (4) is not the answer because saddle joint is not present in between humerus and pectoral girdle.

176. Given below are two statements:

Statement I: RNA mutates at a faster rate.

Statement II: Viruses having RNA genome and shorter life span mutate and evolve faster.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **Statement I** and **Statement II** are false.

(2) **Statement I** is true but **Statement II** is false.

(3) **Statement I** is false but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are true.

Answer (4)

Sol. RNA being unstable, mutate at a faster rate. Consequently, viruses having RNA genome and having shorter life span mutate and evolve faster.

177. Given below are two statements:

Statement I: In prokaryotes, the positively charged DNA is held with some negatively charged proteins in a region called nucleoid.

Statement II: In eukaryotes, the negatively charged DNA is wrapped around the positively charged histone octamer to form nucleosome.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **Statement I** and **Statement II** are false.

(2) **Statement I** is correct but **Statement II** is false.

(3) **Statement I** is incorrect but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are true.

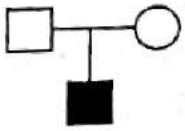
Answer (3)

Sol. In prokaryotes, the negatively charged DNA is held with some positively charged proteins in a region termed as nucleoid.

In eukaryotes, the negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome.

178. Which one of the following symbols represents mating between relatives in human pedigree analysis?

(1)

(2) 

(3)

(4)

Answer (1)

Sol. The symbol representing mating between relatives (consanguineous mating) in human pedigree analysis is

179. Select the correct group/set of Australian Marsupials exhibiting adaptive radiation.

(1) Numbat, Spotted cuscus, Flying phalanger

(2) Mole, Flying squirrel, Tasmanian tiger cat

(3) Lemur, Anteater, Wolf

(4) Tasmanian wolf, Bobcat, Marsupial mole

Answer (1)

Sol. Option (1) is the correct answer because numbat, spotted cuscus and flying phalanger are Australian marsupials exhibiting adaptive radiation.

Option (2) is incorrect because mole and flying squirrel are placental mammals.

Option (3) is incorrect because lemur and wolf are placental mammals.

Option (4) is incorrect because bobcat is a placental mammal.

180. Which of the following is not a cloning vector?

(1) YAC

(2) pBR322

(3) Probe

(4) BAC

Answer (3)

Sol. Option (3) is correct answer because a single stranded DNA or RNA tagged with a radioactive molecule is called a probe and it helps in the detection of mutated gene.

Option (1), (2) and (4) are not correct because YAC, BAC, pBR322 are vectors.

181. Match **List I** with **List II**.

	List I		**List II**
A.	Heroin	I.	Effect on cardiovascular system
B.	Marijuana	II.	Slow down body function
C.	Cocaine	III.	Painkiller
D.	Morphine	IV.	Interfere with transport of dopamine

Choose the **correct** answer from the options given below:

(1) A-I, B-II, C-III, D-IV

(2) A-IV, B-III, C-II, D-I

(3) A-III, B-IV, C-I, D-II

(4) A-II, B-I, C-IV, D-III

Answer (4)

Sol. The correct answer is option (4) as

- Heroin belongs to the category of opioids and it is a depressant that slows down body functions.
- Marijuana is known for its effect on the cardiovascular system of the body.
- Cocaine interferes with the transport of the neurotransmitter dopamine.

Morphine is used is a sedative and painkiller.

182. Which one of the following techniques does not serve the purpose of early diagnosis of a disease for its early treatment?

(1) Serum and Urine analysis

(2) Polymerase Chain Reaction (PCR) technique

(3) Enzyme Linked Immuno-Sorbent Assay (ELISA) technique

(4) Recombinant DNA Technology

Answer (1)

Sol. The correct answer is option (1) because using conventional methods of diagnosis like serum and urine analysis, *etc*, do not help in early diagnosis. Recombinant DNA technology, Polymerase Chain Reaction [PCR] and Enzyme Linked Immuno-Sorbent Assay (ELISA) are some of the techniques that serve the purpose of early diagnosis.

183. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A: Endometrium is necessary for implantation of blastocyst.

Reason R: In the absence of fertilization, the corpus luteum degenerates that causes disintegration of endometrium.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.

(2) **A** is true but **R** is false.

(3) **A** is false but **R** is true.

(4) Both **A** and **R** are true and **R** is the correct expiation of **A**.

Answer (1)

Sol. Option (1) is the correct answer because both Assertion and Reason are true.

Implantation is embedding of the blastocyst into endometrium of uterus.

Correct explanation of reason is

Corpus luteum secretes large amount of progesterone which is essential for maintenance of endometrium of uterus. In absence of fertilisation, the corpus luteum degenerates hence the decrease in the level of progesterone hormone will cause disintegration of endometrium leading to menstruation.

184. Match **List I** with **List II**.

	List I		List II
A.	Gene 'a'	I.	β-galactosidase
B.	Gene 'y'	II.	Transacetylase
C.	Gene 'i'	III.	Permease
D.	Gene 'z'	IV.	Repressor protein

Choose the **correct** answer from the options given below:

(1) A-II, B-III, C-IV, D-I
(2) A-III, B-IV, C-I, D-II
(3) A-III, B-I, C-IV, D-II
(4) A-II, B-I, C-IV, D-III

Answer (1)

Sol. In a *lac* operon,

Gene a codes for enzyme transacetylase.

Gene y codes for enzyme permease.

Gene i codes for repressor protein

Gene z codes for enzyme β-galactosidase.

185. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A: Nephrons are of two types: Cortical & Juxta medullary, based on their relative position in cortex and medulla.

Reason R: Juxta medullary nephrons have short loop of Henle whereas, cortical nephrons have longer loop of Henle.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.

(2) **A** is true but **R** is false.

(3) **A** is false but **R** is true.

(4) Both **A** and **R** are true and **R** is the correct explanation of **A**.

Answer (2)

Sol. The correct answer is option (2) because Assertion is true as there are two types of nephrons, *i.e.*, cortical nephrons and juxtamedullary nephrons based on their relative position in the cortex and medulla. Reason is not correct as loop of Henle in juxtamedullary nephrons is very long and runs deep into the medulla. Therefore, Assertion is true but Reason is false.

SECTION-B

186. Which of the following is characteristic feature of cockroach regarding sexual dimorphism?

(1) Presence of anal styles
(2) Presence of sclerites
(3) Presence of anal cerci
(4) Dark brown body colour and anal cerci

Answer (1)

Sol. Option (1) is the correct answer because anal styles are present in male cockroaches and absent in female cockroaches.

Option (2), (3) and (4) are not the correct answers because sclerites, anal cerci and dark brown body colour are common features of both male and female cockroaches.

187. Select the correct statements.

A. Tetrad formation is seen during Leptotene.

B. During Anaphase, the centromeres split and chromatids separate.

C. Terminalization takes place during Pachytene.

D. Nucleolus, Golgi complex and ER are reformed during Telophase.

E. Crossing over takes place between sister chromatids of homologous chromosome.

Choose the **correct** answer from the options given below:

(1) B and D only

(2) A, C and E only

(3) B and E only

(4) A and C only

Answer (1)

Sol. • Tetrad formation is seen during zygotene stage

- During Anaphase, the centromeres split and chromatids separate.
- Terminalisation of chiasmata takes place during diakinesis.
- Nucleolus, golgi complex and ER are reformed during telophase.
- Crossing over takes place between non-sister chromatids of homologus chromosomes.

188. Which of the following statements are correct?

A. An excessive loss of body fluid from the body switches off osmoreceptors.

B. ADH facilitates water reabsorption to prevent diuresis.

C. ANF causes vasodilation.

D. ADH causes increase in blood pressure.

E. ADH is responsible for decrease in GFR.

Choose the **correct** answer from the options given below:

(1) B, C and D only

(2) A, B and E only

(3) C, D and E only

(4) A and B only

Answer (1)

Sol. Option (1) is the correct answer because statements B, C and D are true statements. ADH facilitates water reabsorption from DCT of nephron to prevent diuresis, which causes increase in blood pressure. ANF which is secreted by the heart is a vasodilator.

Options (2), (3) and (4) are not correct because statements A and E are false. Excessive loss of body fluid from the body switches on the osmoreceptors.

189. Given below are two statements:

Statement I : During G_0 phase of cell cycle, the cell is metabolically inactive.

Statement II : The centrosome undergoes duplication during S phase of interphase.

In the light of the above statements, choose the **most appropriate** answer from the options given below:

(1) Both **Statement I** and **Statement II** are incorrect.

(2) **Statement I** is correct but **Statement II** is incorrect.

(3) **Statement I** is incorrect but **Statement II** is correct.

(4) Both **Statement I** and **Statement II** are correct

Answer (3)

Sol. Cells in the G_0 stage remain metabolically active but no longer proliferate unless called on to do so depending on the requirement of the organism.

In animal cells, during the S-phase, DNA replication begins in the nucleus, and the centriole duplicates in the cytoplasm.

190. Which one of the following is NOT an advantage of inbreeding?

(1) It exposes harmful recessive genes but are eliminated by selection.

(2) Elimination of less desirable genes and accumulation of superior genes takes place due to it.

(3) It decreases the productivity of inbred population, after continuous inbreeding.

(4) It decreases homozygosity.

Answer (3)

Sol. Option (3) is the correct answer because decreasing the productivity of inbred population is not an advantage of inbreeding.

Options (1) and (2) are not the answers because they are the advantages of inbreeding.

Option (4) is an incorrect statement.

191. Match **List I** with **List II**.

List I	**List II**
A. Logistic growth	I. Unlimited resource availability condition
B. Exponential growth	II. Limited resource availability condition
C. Expanding age pyramid	III. The percent individuals of pre-reproductive age is largest followed by reproductive and post reproductive age groups
D. Stable age pyramid	IV. The percent individuals of pre-reproductives and reproductive age group are same

Choose the **correct** answer from the options given below:

(1) A-II, B-III, C-I, D-IV

(2) A-II, B-IV, C-I, D-III

(3) A-II, B-IV, C-III, D-I

(4) A-II, B-I, C-III, D-IV

Answer (4)

Sol. Logistic growth occurs when there is limited resource availability condition.

Exponential growth occurs when there is unlimited resource availability condition.

Expanding age pyramid reflects growing population where the percent individuals of pre-reproductive age is largest followed by reproductive and post-reproductive age groups.

Stable age pyramid shows stable population where the percent individuals of pre-reproductive and reproductive age group are same.

192. Which of the following are NOT under the control of thyroid hormone?

A. Maintenance of water and electrolyte balance

B. Regulation of basal metabolic rate

C. Normal rhythm of sleep-wake cycle

D. Development of immune system

E. Support the process of RBCs formation

Choose the **correct** answer from the options given below:

(1) B and C only
(2) C and D only
(3) D and E only
(4) A and D only

Answer (2)

Sol. Option (2) is the correct answer because thyroid hormones play an important role in the regulation of basal metabolic rate, maintenance of water and electrolyte balance and support the process of RBCs formation, whereas this hormone is not involved in regulating normal rhythm of sleep-wake cycle and development of immune system.

193. The unique mammalian characteristics are:

(1) hairs, pinna and mammary glands

(2) hairs, pinna and indirect development

(3) pinna, monocondylic skull and mammary glands

(4) hairs, tympanic membrane and mammary glands

Answer (1)

Sol. Option (1) is correct answer because presence of hairs, pinna and mammary glands are unique features of mammals.

Options (2), (3) and (4) are not correct because, monocondylic skull is present in reptiles and aves whereas mammals have dicondylic skull. Tympanic membrane is present in amphibians also, so it is not considered as unique feature.

Indirect development is not seen in mammals.

194. Which of the following statements are correct regarding skeletal muscle?

A. Muscle bundles are held together by collagenous connective tissue layer called fascicle.

B. Sarcoplasmic reticulum of muscle fibre is a store house of calcium ions.

C. Striated appearance of skeletal muscle fibre is due to distribution pattern of actin and myosin proteins.

D. M line is considered as functional unit of contraction called sarcomere.

Choose the **most appropriate** answer from the options given below:

(1) B and C only
(2) A, C and D only
(3) C and D only
(4) A, B and C only

Answer (1)

Sol. Option (1) is the correct answer because statements B and C are only correct statements while A and D are incorrect statements.

Muscle bundles are held together by collagenous connective tissue layer called fascia. Muscle bundles are called fascicles. The portion of the myofibril between two successive 'Z' lines is considered as functional unit of contraction called sarcomere.

195. Which of the following statements are correct?

A. Basophils are most abundant cells of the total WBCs

B. Basophils secrete histamine, serotonin and heparin

C. Basophils are involved in inflammatory response

D. Basophils have kidney shaped nucleus

E. Basophils are agranulocytes

Choose the **correct** answer from the options given below:

(1) C and E only
(2) B and C only
(3) A and B only
(4) D and E only

Answer (2)

Sol. Option (2) is the answer because, basophils secrete histamine, serotonin, heparin *etc.* and are involved in inflammatory response.

Option (1) is not the answer because, basophils are granulocytes.

Option (3) is not the answer because, neutrophils are the most abundant cells (60–65 %) of the total WBCs whereas basophils are least (0.5–1%) abundant of all WBCs.

Option (4) is not the answer because, monocytes have a kidney-shaped nucleus.

196. Which one of the following is the sequence on corresponding coding strand, if the sequence on mRNA formed is as follows 5'AUCGAUCGAUCGAUCGAUCGAUCG AUCG 3'?

(1) 3' UAGCUAGCUAGCUAGCUAGCUAGCUAGC 5'

(2) 5' ATCGATCGATCGATCGATCGATCGATCG 3'

(3) 3' ATCGATCGATCGATCGATCGATCGATCG 5'

(4) 5' UAGCUAGCUAGCUAGCUAGCUAGCUAGC 3'

Answer (2)

Sol. The sequence of coding strand is same as RNA except thymine at the place of uracil.

Template strand → 3'-TAGCTAGCTAGCTAGCTAGCTAGCTAGC-5'

Coding strand → 5'-ATCGATCGATCG ATCGATCGATCGATCG-3'

↓ Transcription

mRNA → 5' AUCGAUCGAUCGAUCGAUCGAUCG AUCG 3'

197. The parts of human brain that helps in regulation of sexual behaviour, expression of excitement, pleasure, rage, fear etc. are:

(1) Corpora quadrigemina and hippocampus
(2) Brain stem and epithalamus
(3) Corpus callosum and thalamus
(4) Limbic system and hypothalamus

Answer (4)

Sol. Option (4) is the correct answer because limbic system along with hypothalamus regulate the sexual behaviour, expression of excitement, pleasure, rage, fear, *etc.*

Option (1), (2) and (3) are not correct because corpora quadrigemina is a part of the midbrain and consists of four round swellings. Corpus callosum is a tract of nerve fibres that connects right and left cerebral hemispheres. Thalamus is a major coordinating centre in the forebrain for sensory and motor signalling. Midbrain, pons and medulla oblongata together form the brain stem.

198. Match **List I** with **List II.**

	List I		List II
A.	Mast cells	I.	Ciliated epithelium
B.	Inner surface of bronchiole	II.	Areolar connective tissue
C.	Blood	III.	Cuboidal epithelium
D.	Tubular parts of nephron	IV.	Specialised connective tissue

Choose the **correct** answer from the options give below:

(1) A-II, B-III, C-I, D-IV
(2) A-II, B-I, C-IV, D-III
(3) A-III, B-IV, C-II, D-I
(4) A-I, B-II, C-IV, D-III

Answer (2)

Sol. Option (2) is the correct answer because,

- Areolar connective tissue contains fibroblasts (cells that produce and secrete fibres), macrophages and mast cells.
- Inner surface of bronchioles is lined by ciliated epithelium.
- Blood is a specialised connective tissue.
- Tubular parts of nephron are lined by cuboidal epithelium.

199. In cockroach, excretion is brought about by-

A. Phallic gland
B. Urecose gland
C. Nephrocytes
D. Fat body
E. Collaterial glands

Choose the correct answer from the options given below :

(1) A, B and E only
(2) B, C and D only
(3) B and D only
(4) A and E only

Answer (2)

Sol. Option (2) is the answer because,

In cockroach, excretion is brought about by Malpighian tubules, fat body, nephrocytes and urecose glands.

Urecose glands are present in male cockroach of some species. They synthesise uric acid. Nephrocytes are large, colourless, ovoid, binucleate cells attached to the dorsal diaphragm in the body cavity. Fat body accumulates, produces and stores uric acid.

Phallic gland is the structure of male reproductive system of cockroach and it secretes the outer layer of spermatophore. Collaterial gland is the structure of female reproductive system of cockroach and it secretes the hard egg-case or ootheca around fertilised eggs.

200. Select the correct statements with reference to chordates.

A. Presence of a mid-dorsal, solid and double nerve cord.

B. Presence of closed circulatory system.

C. Presence of paired pharyngeal gill slits.

D. Presence of dorsal heart

E. Triploblastic pseudocoelomate animals.

Choose the **correct** answer from the options given below:

(1) B and C only

(2) B, D and E only

(3) C, D and E only

(4) A, C and D only

Answer (1)

Sol. Option (1) is the correct answer because statements B and C only are correct. Option (2), (3) and (4) are not correct. The chordate characters are presence of closed circulatory system and presence of pharyngeal gill slits. Nerve cord is dorsal, hollow and single. Heart is ventral. They are triploblastic and coelomate.

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